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Bethesda, Maryland 20034

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RIGID BODY SHIP RESPONSES AND ASSOCIATED PERIODS FOR A SERIES OF LIQUID NATURAL GAS (LNG) SHIPS

by

Susan L. Bales
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and
William G. Meyers

SHIP PERFORMANCE DEPARTMENT

April 1975 Report SPD-517-04

The Naval Ship Research and Development Center is a U. S. Navy center for laboratory effort directed at achieving improved sea and air vehicles. It was formed in March 1967 by merging the David Taylor Model Basin at Carderock, Maryland with the Marine Engineering Laboratory at Annapolis, Maryland.

Naval Ship Research and Development Center
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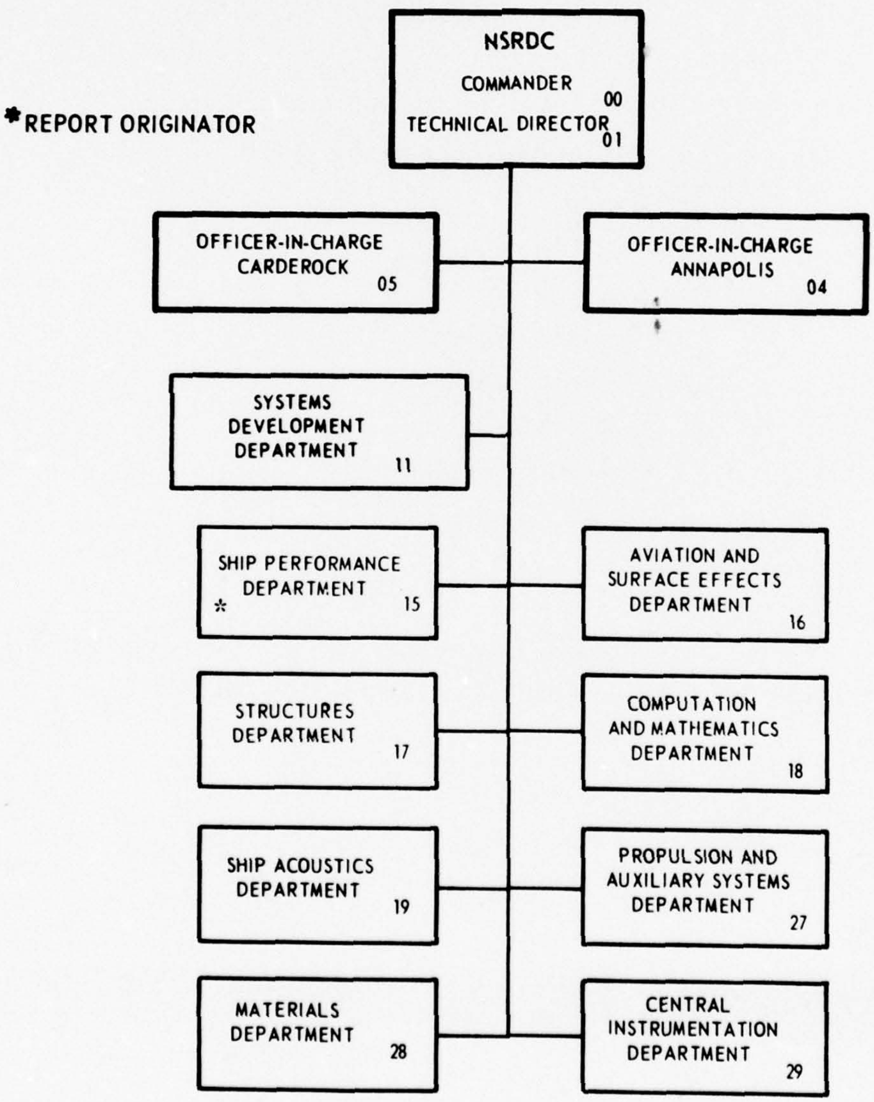

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A procedure to determine extreme ship responses has been developed and previously reported in a pilot investigation for prediction of extreme tank accelerations of Liquid Natural Gas (LNG) ships. Essentially, extreme accelerations and motions are developed by applying short-term statistics to hull responses predicted for severe sea conditions. The procedure requires three inputs to determine the extreme values:

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(1) Root mean square (RMS) ship responses

(2) Extreme wave heights from historical data of ocean areas which serve as LNG shipping routes

(3) Probability of exceeding a certain response level within a specified time.

The purpose of this report is to develop the RMS ship responses required to determine LNG tank design (extreme) acceleration rules. The actual design rule work is presented in a separate paper.

The RMS data base presented is for a series of five LNG ships ranging in length from approximately 600 to 1000 feet and with capacities ranging from 29,000 to 200,000 cubic meters. Ships with both spherical and membrane tanks are included. The data base consists of six rigid body ship responses, i.e., heave, pitch and roll along with longitudinal, lateral and vertical accelerations at the center of the forward tank for each of nine ship/load cases. Periods associated with each response are also given.

The data base covers a wide range of ship speeds, i.e., 0, 5, . . ., 20 knots, ship headings, i.e., 0, 15, . . ., 180 degrees and modal wave periods, i.e., 7, 9, . . ., 21 seconds. The seaways are represented by short crested Bretschneider two-parameter spectra with one foot significant wave heights, so that the data can easily be scaled to any wave height. The effect of load variations is evaluated by determining ship responses when GM is varied.

The data base presented is easy to access and considered applicable to many ship design and engineering problems. It is presented in tabular form with supportive two and three dimensional trend plots. The procedure used to generate the data base is outlined. Examples of data base uses are given with specific reference to LNG tank design accelerations.

C.P.
O.S.

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NOTATION

AP	Aft perpendicular
BL	Baseline
B_X	Maximum ship beam
b_j	Spreading function (time domain) for short crested seas
C_B	Block coefficient
C_P	Longitudinal prismatic coefficient
C_T	Confidence factor
C_X	Maximum transverse section coefficient
FP	Forward perpendicular
F_n	Froude number
GM	Transverse metacentric height
g	Acceleration due to gravity, 32.1725 ft/sec^2
KG	Height of center of gravity above baseline
K_ϕ, K_θ, K_ψ	Roll, pitch, and yaw radii of gyration
L_{PP}	Length between perpendiculars of ship
L_O, L_A, L_V	Longitudinal, lateral, and vertical displacements
$L_{\ddot{O}}, L_{\ddot{A}}, L_{\ddot{V}}$	Longitudinal, lateral, and vertical accelerations at any point (x*, y*, z*) along the ship
RAO	Response amplitude operator
RMS	Root mean square, square root of variance
$R_A(\omega_E, \nu)$	Amplitude of ship response to a sinusoidal excitation, frequency-response function
$R_{L_O}(\omega_E, \nu), R_{L_A}(\omega_E, \nu), R_{L_V}(\omega_E, \nu)$	Longitudinal, lateral, and vertical displacement frequency-response functions at any point (x*, y*, z*) along the ship

$r(t)$	Response time history
S	Response spectrum
$S_{\zeta}(\omega)$	Long crested wave spectral density ordinates
$S_{\zeta}(\omega_E)$	Encountered long crested wave spectral density ordinates
$S_{\zeta}(\omega_E,\nu)$	Encountered short crested wave spectral density ordinates for wave direction ν
$s(t)$	Wave height time history
s_k	Long crested wave spectral component in time domain simulation
T,t	Time variable
$T_{AP}, T_{\otimes}, T_{FP}$	Ship draft at aft perpendicular, amidships, and forward perpendicular
T_{MAX}	Period of maximum response cycle
T_{OE}	Modal response period, period corresponding to peak of encountered response spectrum
T_X	Maximum ship draft
T_o	Modal wave period, period corresponding to peak of wave spectrum
T_{ϕ}	Natural roll period, approximately $1.108\ K_{\phi}/\sqrt{GM}$
V	Ship speed
X	Extreme ship response
x^*, y^*, z^*	Coordinates of any point measured from the origin of the calculation procedure defined on page 8
x, x_A	Surge and surge amplitude
$(x_A/\zeta_A)_{\ell im}$	Empirically derived surge limit in quartering/following waves
y, y_A	Sway and sway amplitude
$(y_A/\zeta_A)_{\ell im}$	Empirically derived sway limit in quartering/following waves

z, z_A	Heave and heave amplitude
γ_{jk}	Random phase angle associated with the heading angle and the wave frequency of short crested time history
Δ	Ship displacement
ε_k	Phase angle of frequency response function
ζ_A	Wave amplitude - single amplitude
$(\tilde{\zeta}_w)_{1/3}$	Significant wave height - average of one-third highest double amplitudes
θ, θ_A	Pitch and pitch amplitude
λ	Wavelength
μ	Ship heading angle, predominant wave direction with respect to the ship
ν	Wave direction, with respect to the ship, apart from the predominant direction
$\sigma, \sigma_{sc}(\mu)$	RMS or standard deviation of ship response in short crested seas
$\sigma^2_{\ell c}(\mu), \sigma^2_{sc}(\mu)$	Mean square or variance of ship response in long crested seas, in short crested seas
ϕ, ϕ_A	Roll and roll amplitude
χ	Wave direction with respect to the predominant wave direction
ψ, ψ_A	Yaw and yaw amplitude
$(\psi_A/\zeta_A)_{\ell im}$	Empirically derived yaw limit in quartering/following waves
ω	Wave frequency
ω_E	Wave encounter frequency
$\omega_E{}^*$	Wave encounter frequency above which ship response is negligible
$2\zeta_A/\lambda$	Wave steepness
⊕	Midlength - between perpendiculars, midships

ABSTRACT

A procedure to determine extreme ship responses has been developed and previously reported in a pilot investigation for prediction of extreme tank accelerations of Liquid Natural Gas (LNG) ships. Essentially, extreme accelerations and motions are developed by applying short-term statistics to hull responses predicted for severe sea conditions. The procedure requires three inputs to determine the extreme values:

1. Root mean square (RMS) ship responses
2. Extreme wave heights from historical data of ocean areas which serve as LNG shipping routes
3. Probability of exceeding a certain response level within a specified time

The purpose of this report is to develop the RMS ship responses required to determine LNG tank design (extreme) acceleration rules. The actual design rule work is presented in a separate paper.

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The data base covers a wide range of ship speeds, i.e., 0, 5, . . ., 20 knots, ship headings, i.e, 0, 15, . . ., 180 degrees and modal wave periods, i.e., 7, 9, . . ., 21 seconds. The seaways are represented by short crested Bretschneider two-parameter spectra with one foot significant wave heights, so that the data can easily be scaled to any wave height. The effect of load variations is evaluated by determining ship responses when GM is varied.

The data base presented is easy to access and considered applicable to many ship design and engineering problems. It is presented in tabular form with supportive two and three dimensional trend plots. The procedure used to generate the data base is outlined. Examples of data base uses are given with specific reference to LNG tank design accelerations.

ADMINISTRATIVE INFORMATION

This work was conducted at the Naval Ship Research and Development Center (NSRDC) upon request of the U.S. Coast Guard (USCG), MIPR Z-70099-3-30922. It is identified as Work Unit Number 1-1568-004.

INTRODUCTION

The importance of liquid natural gas as a source of energy has been steadily growing in the past few years. Fear of scarcity or unreliability of energy sources and emphasis on environmental protection have influenced its rising importance in the United States as well as other countries. One major result of this is that a new class of ships, LNG Carriers, is being developed.

The United States Coast Guard (USCG) is responsible for the safety of all hazardous cargo ships entering or leaving U.S. harbors, including, of course, LNG ships. Therefore, the USCG has sponsored research programs to improve the evaluation and specification of LNG ship safety. As a consequence, NSRDC has been contracted by USCG to explore procedures which may result in more realistic classification rules.

This NSRDC program has been broken into three phases over a period of two years:

1. Phase I - Conduct a pilot investigation to develop a procedure for determining extreme ship responses and apply it to a typical LNG ship.
2. Phase II - Modify procedure of Phase I where required, to accommodate a representative range of LNG ships. Develop a data

base of root mean square ship responses and associated periods for all possible ship headings, speeds and sea conditions. The data base format should permit easy access for wide range of applications including LNG tank design.

3. Phase III - Using Phase II data base, determine extreme ship responses and compare with current tank design classification rules. The results should be in a form easily comprehensible to the tank designer, e.g., as a function of ship length. Internal tank pressures due to liquid head should be examined.

The Phase I work has been completed and reported.[1*] This report presents the results of Phase II. A comprehensive report detailing Phase III work is in preparation. A summary of all phases of the program has been recently presented at the GASTECH '74 LNG/LPG Congress in Amsterdam, Netherlands.[2]

The present report is divided into several major sections:

1. Series Description
2. Prediction Procedure
3. Results
4. Application of Results
5. Concluding Remarks.

SERIES DESCRIPTION

The five ships selected for the LNG ship series are described in Figure 1 and Table 1. Ships were selected for the series in an effort to describe a representative range of LNG carriers likely to enter U.S. ports, both now and in the future. The ship lengths vary from approximately 600 to 1000 feet and the cargo capacities range from 29,000 to 200,000 cubic meters. Ships A and C have spherical tanks; Ships B, D, and E have membrane tanks. The ships are considered to be in the full or nearly full cargo load condition and each ship is assumed to possess typical bilge keels for purposes of ship lateral response predictions.

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*Superscripts denote references listed on page 111.

TABLE 1 - LNG SERIES SHIP PARTICULARS

LIQUID NATURAL GAS (LNG) SHIP SERIES

Ship	Loaded Condition	No. of Tanks, Design	LNG Capacity ($10^3 \cdot M^3$)	Speed (Knots)	Displacement (10^3 L. Tons)	L_{PP} (Feet)	B_X (Feet)	T_X (Feet)	C_B	C_X	C_P	KG (Feet)	GM (Feet)	T_{AP} (Feet)	T_M (Feet)	T_{FP} (Feet)	T_ϕ (Sec)	K_ϕ % B_X	K_θ % L_{PP}	K_ψ % L_{PP}
A	Full Bunkers, Tanks 99% Ethylene, Arrival	4, Spherical	29.0	19.7	30	561.0	95.0	29.2	0.68	0.98	0.69	37.3	3.0	1.4	29.2	29.0	21.3	0.35	0.25	0.25
B	Methane Loaded	5, Membrane	35.0	23.0	35	603.7	87.0	31.9	0.73	0.98	0.74	34.7, 33.2, 30.2	1.5, 3.0, 6.0	4.4	31.9	31.7	27.6, 19.5, 13.8	0.35	0.25	0.25
C	Tanks 98, 99, 99,99, 40% Propane, Dep., Fuel 6000 naut. mi.	5, Spherical	87.6	19.0	73	777.6	131.2	34.8	0.72	0.99	0.72	54.4, 53.4, 52.4	2.0, 3.0, 4.0	0.0	34.8	34.4	36.0, 29.4, 25.5	0.35	0.25	0.25
D	Fully Loaded	6, Membrane	120.0	19.0	84	839.7	134.5	34.4	0.75	0.99	0.76	50.8	8.6	<3.2	34.4	33.7	17.8	0.35	0.25	0.25
E	Fully Loaded Methane Departure	6, Membrane	200.0	18.8	140	951.5	157.5	41.4	0.79	0.98	0.80	58.0	11.6	0.0	41.35	41.04	17.9	0.35	0.25	0.25

NOTE: L_{PP} is length between perpendiculars, B_X is maximum beam, T_X is maximum draft, C_B is block coefficient, C_X is maximum section coefficient, C_P is prismatic coefficient, KG is vertical center of gravity above baseline, GM is transverse metacentric height, T_{AP}, T_M, T_{FP} are the draft at the aft perpendicular, midships, and the forward perpendicular, T_ϕ is the roll period approximated by $T_\phi = 1.108(K_\phi)/\sqrt{GM}$, and K_ϕ, K_θ, and K_ψ are the radii of gyration for roll, pitch, and yaw.

The effect of load variation on predicted accelerations is examined for two of the ships by simple GM variations rather than by combined draft, trim, displacement and GM variations. This is considered appropriate because current full-scale ballasting procedures maintain LNG ships at essentially a constant draft, without regard to the liquid natural gas cargo load status. Ships B and C are selected for these GM variations; both ships are permitted three separate GM values as shown in Figure 1 and Table 1. Each ship/GM case is treated separately, thus the LNG ship series consists of nine unique ship/load conditions.

PREDICTION PROCEDURE

The general prediction procedure is outlined in Reference 1. Some modifications and additions have been made to this general procedure for its application to the LNG ship series. Figure 2 outlines the major computational elements of the procedure. In brief, the calculations are performed in two steps, denoted A and B in Figure 2. Part A provides the six-degree-of-freedom response amplitude operators applicable to motions near the CG of the ship by applying state-of-the-art ship motion theory. Part B "translates" these operators to obtain operators applicable to the center of the forward tank, and then computes the ship responses in short crested seas using theoretical two-parameter wave spectra. In addition, modal periods associated with the responses are determined. The items numbered 1, 3, and 7 in part B are the major modifications and additions which have been made to the general procedure given in Reference 1. These items are described in this section of the report and a brief description of the entire procedure is also given.

RESPONSES

Statistical predictions of ship responses are found essentially by the procedure of St. Denis and Pierson.[3] This procedure assumes that the seaway and ship responses to it are stationary Gaussian random processes and that the principle of linear superposition holds. A cosine-squared law is used to spread the wave energy from long crested (uni-directional) to short crested

(multi-directional) seas. In summary, the response variance, $\sigma^2_{sc}(\mu)$, in short crested seas at a given ship speed V and ship heading angle μ is

$$\sigma^2_{sc}(\mu) = \int_{\mu - \pi/2}^{\mu + \pi/2} \int_{0}^{\omega_E^*} [R_A\ (\omega_E, \nu)]^2\ S_\zeta(\omega_E, \nu)\ d\omega_E\ d\nu \qquad (1)$$

where ν is the wave direction with respect to the ship, ω_E is the encountered wave frequency, $\omega_E{}^*$ is the encountered frequency above which ship response is negligible, and $[R_A\ (\omega_E, \nu)]^2$ is the response amplitude operator. $S_\zeta(\omega_E, \nu)$ is the short crested encountered wave spectrum defined by

$$S_\zeta(\omega_E, \nu) = (2/\pi)\ \cos^2\ (\nu - \mu)\ S_\zeta(\omega_E) \qquad (2)$$

where $S_\zeta(\omega_E)$ represents the long crested encountered wave spectrum. Substituting equation 2 into equation 1,

$$\sigma^2_{sc}(\mu) = (2/\pi) \int_{\mu - \pi/2}^{\mu + \pi/2} \cos^2\ (\nu - \mu) \int_{0}^{\omega_E^*} [R_A\ (\omega_E, \nu)]^2\ S_\zeta(\omega_E)\ d\omega_E\ d\nu \qquad (3)$$

and for the integration over wave direction, ν, values of the integrand at $\nu = \mu + p\pi/12$ where p = -6, -5, . . ., 0, . . ., 5, 6, are summed and multiplied by $\pi/12$, i.e.,*

$$\sigma^2_{sc}(\mu) = (1/6) \sum_{p=-6}^{6} \sigma^2_{\ell c}\ (\mu + p\pi/12)\ \cos^2\ (p\pi/12) \qquad (4)$$

where

$$\sigma^2_{\ell c}\ (\mu + p\pi/12) = \int_{0}^{\omega_E^*} [R_A\ (\omega_E, \mu + p\pi/12)]^2\ S_\zeta(\omega_E)\ d\omega_E \qquad (5)$$

---

*Both the ship response and the spreading function are assumed constant for a given encountered wave frequency over each $\pi/12$ interval of ship heading.

is the response variance in long crested (uni-directional) seas at an angle $(\mu + p\pi/12)$ with respect to the ship.

Due to conservation of energy

$$S_\zeta(\omega_E)\ d\omega_E = S_\zeta(\omega)\ d\omega \tag{6}$$

where ω is the wave frequency, and by definition

$$d\omega_E = (\partial\omega_E/\partial\omega)\ d\omega \tag{7}$$

therefore,

$$S_\zeta(\omega_E)\ d\omega_E = S_\zeta(\omega)\ (\partial\omega/\partial\omega_E)\ d\omega_E$$

$$= S_\zeta(\omega)\ [1/(\partial\omega_E/d\omega)]\ d\omega_E \tag{8}$$

The encountered wave frequency is defined by

$$\omega_E = \omega - (\omega^2 V/g)\cos\nu \tag{9}$$

where g is the acceleration due to gravity, so

$$(\partial\omega_E/\partial\omega) = |1 - (2\omega V/g)\cos\nu| \tag{10}$$

Substituting equation 10 into equation 8,

$$S_\zeta(\omega_E)\ d\omega_E = S_\zeta(\omega)\ |1/[1 - (2\omega V/g)\cos\nu]|\ d\omega_E \tag{11}$$

The absolute value is taken in quation 10 to prevent the case of negative frequencies of encounter. The quantity $1/(\partial\omega_E/\partial\omega)$ of equation 8 is the Jacobian of the transformation from the wave frequency domain to the encountered wave frequency domain, see Reference 5.

In summary, equation 4 describes the response variance used in this work. Details of the calculation procedure needed to compute equation 4 are presented below.

Response Amplitude Operator, RAO

Ship motion response amplitude operators were computed using the NSRDC Ship Motion and Sea Load Computer Program,[4] which is based on theory by Salvesen, Tuck and Faltinsen.[5] Surge, sway, heave, roll, pitch, and yaw RAOs were computed for the intersection* of the longitudinal centerline of the waterplane section with the transverse plane through the center of gravity. Figure 3 presents a typical set of RAOs for Ship A at 10 knots. The RAOs are given as a function of wave frequency, ω,** for ship headings ranging from 0 to 180 degrees in 15 degree increments, where head seas are at 180 degrees.

Ship acceleration response amplitude operators for the center of the forward tanks are computed by the NSRDC Irregular Sea Response Prediction Program. The procedure is outlined in Reference 6. Briefly, the ship responses at any point (x^*, y^*, z^*) along the ship are determined by the translation equations

$$
\begin{aligned}
L_O &= x - y^*\psi + z^*\theta \\
L_A &= y - z^*\phi + x^*\psi \\
L_V &= z - x^*\theta + y^*\phi
\end{aligned}
\qquad (12)
$$

where L_O, L_A, and L_V are the ship displacements in the longitudinal, lateral, and vertical directions, and x, y, z, ϕ, θ, ψ are surge, sway, heave, roll,

---

*This point is the origin of the coordinate system used in the calculation procedure.

**In practice, the computational ω and ω_E ranges are determined from the wavelength to ship length ratios, λ/L_{PP}, input to the NSRDC Ship Motion and Sea Load Computer Program. That is, RAOs are computed for ω_E values determined from

$$\omega = (2\pi g/\lambda)^{\frac{1}{2}}$$

and equation 9. The λ/L_{PP} range used for this work is 0.1 to 4.2.

pitch, and yaw motions at the origin. The corresponding response amplitude operators $R_{L_O}(\omega_E, \nu)$, $R_{L_A}(\omega_E, \nu)$ and $R_{L_V}(\omega_E, \nu)$ are easily determined by calculating real and imaginary parts of L_O, L_A, and L_V for a given encounter frequency.

The acceleration response amplitude operators are found by taking the product of the displacement response amplitude operators and $[\omega_E(\omega)]^4/g^2$. By using the approach of the previous section, the required acceleration variances are found.

Wave Spectrum, S_ζ

The two-parameter Bretschneider spectral form has been used. The two parameters are, by definition, significant wave height, $(\tilde{\zeta}_w)_{1/3}$, and modal (peak) wave period, T_o. The spectral density equation is

$$S_\zeta(\omega) = A\omega^{-5} \exp\,[-B/\omega^4] \quad ft^2 \cdot sec$$

where

$$A = 483.5\,(\tilde{\zeta}_w)^2_{1/3}/T_o^4 \quad ft^2 \cdot sec^{-4}$$

and

$$B = 1944.5/T_o^{\,4} \ sec^{-4} \qquad (13)$$

Equation 13 represents the energy of a long crested (uni-directional) seaway in the ω-domain. A cosine squared law has been applied to equation 13 in order to approximate a more realistic short crested (multi-directional) seaway, i.e., see equation 2. Also the wave spectra are transformed to the encountered wave domain, see equation 11.

The RMS responses presented in this report were computed using wave spectra defined by a significant wave height of 1 foot and modal periods 7, 9, . . ., 21 seconds. Figure 4 illustrates the shape of these wave spectra. The use of the two-parameter spectrum has several advantages over the use of a one-parameter (wave height) spectrum:

1. For a specific wave height, more realistic ship response ranges can be determined, due to a recognition of the wide variations in energy distribution for actual sea states.

2. Observed wave data for a specific oceanographic area may be readily used.

Special Techniques

Due to the wide range of ship sizes and operating conditions, as well as the fact that the primary intended use of the data base is to predict extreme responses, several special (numerical) techniques have been developed and are discussed in this section. It should be emphasized that the first two techniques discussed are simply to surmount computational problems which arise due to the use of linear equations of motion to represent complex non-linear phenomena. This recognizes that the linear equations are not suitable for the prediction of motion divergences which can occur in nature for extreme sea conditions when wave encounter frequencies are very small, e.g., ship broaching and capsizing in extreme quartering or following seas.

Surge, Sway, and Yaw in Quartering and Following Waves. The equations of motion of the linear theory[5] used in this work predict very large RAOs for surge, sway, and yaw responses for near zero wave encounter frequencies. Similar large values for heave, pitch, and roll RAO predictions are not as obvious possibly due to the inclusion of hydrostatic restoring terms in their respective equations of motion.[6] The problem caused no difficulty in the pilot investigation because only a long LNG ship, Ship D, was considered. However, in this work, it has been necessary to consider the difficulty because smaller LNG ships are included. For example, Ship A is approximately two-thirds the length of Ship D and thus reaches lower encounter frequencies than Ship D for the same speed, heading, and wavelength/ship length ratio (λ/L_{pp}) combinations.

Therefore, a procedure has been developed to impose numerical limits on predicted surge, sway, and yaw transfer functions. The imposed limits are derived empirically from measured extreme surge, sway, and yaw model data and are implemented in the NSRDC Irregular Sea Response Prediction Program, see Figure 2. Appendix A gives a detailed description of the procedure. Figure 5 illustrates an application of the procedure to the case of a transfer function for Ship A at relatively high speed in quartering waves. The shaded

area in the figure denotes the area for near zero wave encounter frequency, ω_E, in which a very large sway prediction occurs. For example, at λ/L_{PP} of 0.3 (ω_E = 0.012 radians/second), the sway transfer function is predicted to be $y_A/\zeta_A = 75.1$. According to the empirical limits derived in Appendix A, the sway transfer function limit, $(y_A/\zeta_A)_{lim}$, should not exceed 1.06 for this ship heading.

Roll Nonlinearities. It is known that the principle of linear superposition does not necessarily hold when seaways become extreme. For example, roll motion, which is considered the most nonlinear ship response, tends to reach limiting values rather than continuing to increase linearly with wave height in extreme waves. Figure 6, prepared using unpublished NSRDC model experiment results, illustrates this nonlinear behavior of roll motion. The square symbols in the figure represent measured roll amplitudes and the solid lines represent predicted values for the same conditions at which the experiment was conducted. Figure 6a clearly demonstrates a leveling off of measured roll amplitude ϕ_A with increasing wave height $2\zeta_A$, especially as speed increases. For example, at a Froude number $F_n = 0.15$, roll amplitude appears to level off above a wave height of 30 feet. Figure 6b presents the data of Figure 6a in nondimensional form and illustrates the decrease in measured roll motion per unit wave height as 1/wave steepness decreases (or as wave steepness increases and thus wave height increases).

In both Figures 6a and 6b, it is apparent that the computed roll motion for higher wave heights is overpredicted, especially as speed is increased. Since the data base of this report is primarily intended for determining ship responses in extreme seas, a procedure was developed to predict more realistic extreme sea roll motions using the existing linear theory.[5] Essentially, the procedure develops a roll correction factor dependent only on ship heading and speed which is applied to the RMS roll angles. Appendix B gives details of the procedure.

Spectral Closure. Validity of the predicted RMS responses relies on a proper numerical technique for calculation of the area under each response spectrum. If the response spectrum approaches zero at both high and low frequencies,

the spectrum is considered to close. The response spectrum approaches zero when either the response amplitude operator or the wave spectrum (or both) is small.

Generally it is rather a simple procedure to select a range of λ/L_{PP}* values that assures both sufficient resolution of the response spectrum and closure. However, in the present case, due to the wide spectral frequency range, i.e., 7 to 21 second modal wave periods, and computer program storage limitations, some difficulties arose. Figure 7 defines a procedure whereby small areas can be added to the computed response spectrum to assure closure at both high and low frequencies. The spectrum is considered to close, at either end, if the end spectral value is less than or equal to 10 percent of the peak value, otherwise small areas are added to the original spectrum. For example, if the spectrum does not close at the low frequency end, i.e., $S_1 > 0.1\ S_{max}$, then the smaller of two areas, A_2 or A_3, is added to the originally computed spectral area A_1, see Figure 7. In Figure 7, A_3 is the area of the triangle formed by drawing a straight line through the first two spectral ordinates, and continuing it to the frequency axis. A_2 is the area of the triangle formed by drawing a straight line to the frequency of zero wave energy, e.g., $\omega_o = 0.2$, and is included in the procedure only to ensure that excessively conservative, i.e., large, A_3 values are not added to the originally computed spectral area. If the spectrum does not close at the high frequency end, i.e., $S_n > 0.1\ S_{max}$ and $S_n < S_{n-1}$, then A_4 is added to the originally computed area S_1. A_4 is the area of the triangle formed by drawing a straight line through the last two spectral ordinates, and continuing it to the frequency axis.

Figure 8 gives a typical example of the procedure for heave displacement. In this example, a small area at the low frequency end is added to the original heave spectrum. The small area added, A_2, is considered reasonable because the wave spectrum is quickly going to zero for $\omega < 0.30$. For example, if

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*As noted in the Response Amplitude Operator section, the ω and ω_E values for which responses are calculated are determined from the λ/L_{PP} values input to the NSRDC Ship Motion and Sea Load Computer Program.

the wave spectrum is extended down to $\omega = 0.2$, see dashed line in middle plot of Figure 8, it becomes nearly zero. If the heave RAO is assumed to be 1, at $\omega = 0.25$,* the response spectrum ordinate is 0.083 which is clearly within the A_2 right triangle in the bottom plot of the figure.

PERIODS

In response to frequent U.S. Coast Guard inquiries about the period associated with extreme accelerations, a basic modification to the calculation procedure was made. Previously the procedure was concerned only with predicting ship motions, see Reference 1, and thus all RMS values were computed in the wave frequency, ω, domain, this being the simpler procedure. In order to develop a procedure for determining response periods, however, the response spectra need be examined in the encountered wave frequency, ω_E, domain. Prediction in the ω_E-domain permits analysis of the frequency content of the encountered response spectra and was thus incorporated into the calculation procedure.

This addition to the procedure takes advantage of recently developed U.S. Navy computer programs to predict correlated ship motion time histories. It has been found that the maximum time history response occurs at a period which is close to the modal period, T_{0E}, of the encountered response spectrum. Verification of this finding is given in Appendix C.

Thus, in addition to the root mean square responses, the periods of the responses, T_{0E}, are contained in the LNG series response data base.

RESULTS

DESCRIPTION

The response/period data base for the LNG ship series is presented in Appendix D. Table 2, of the appendix, gives a summary of the data presentation for each ship/load case. Specifically, the data base is presented in three distinct formats:

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*That is, the ship is heaving with the same amplitude as the wave.

1. Figures 17 to 21* present three-dimensional response surfaces where each figure contains the six data base responses for all five ships for a specified speed. The surfaces are functions of ship heading angle, μ, and modal wave period, T_o. The two intermediate load (GM) conditions are shown for Ships B and C. These figures are useful in determining the peaks and valleys of the responses as heading and/or sea condition varies, as well as showing gross differences, or lack of same, of particular responses across the ship series. For example, at 10 knots, see Figure 19, vertical acceleration is largest in bow-to-head seas for modal wave periods from 11 through 13 seconds. Further, at 10 knots, maximum vertical acceleration is greater for Ship B (GM = 3 Ft), i.e., approximately 0.49 g's, than for any other ship; Ship E has the smallest maximum vertical acceleration, i.e., approximately 0.27 g's.
2. Figures 22 to 30** are two-dimensional "density plots" of ship response versus encountered modal period. Each figure is for one ship/load case and contains response-period pairs for all headings and speeds for each response-type. These density plots are very useful in detecting resonant periods, general trends, etc. For example, Ship A, see Figure 22, exhibits the most severe roll angles in the 22 and 23 second encountered modal period range. In the same figure, longitudinal acceleration generally shows little change in highest RMS response across encountered modal period, while vertical acceleration is greatest around 7 to 8 seconds.
3. Tables 3 through 48 present the RMS response encountered modal period pairs, one response-type for one ship/load case per table. Each table contains predictions for all speeds, headings and sea conditions

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* Basic three-dimensional plots were constructed by CalComp's THREE-D perspective drawing software and the 763 drum plotter. The THREE-D package was purchased by this project explicitly to construct the plots for Figures 17 to 21.

** Basic scatter or density plots were constructed using CalComp software and the 763 drum plotter.

(significant wave height of 1 ft). These tables permit a quantitative analysis of ship responses for the LNG ship series. For example, the values given in the tables may be used to evaluate variations in response levels as heading and/or speed changes, to determine extreme lifetime response values for use in design, etc. The examples given in the Application of Results section illustrates the use of these tables.

DISCUSSION

Upon examination of the data base, especially the density and surface plots, several observations can be made. For Figures 17 to 21, the following comments are made:

1. Excluding roll, similar trends are shown for each type of response surface at a specific ship speed, irrespective of ship length.
2. As speed increases, maximum vertical accelerations move from beam to head seas for all ship lengths.
3. Maximum lateral accelerations occur near beam seas for all ship speeds and lengths.
4. As speed increases, maximum heave occurs for high modal wave periods and moves from beam to bow seas, especially for the smaller ship lengths.
5. As speed increases, maximum roll moves from beam to following seas and modal wave periods decrease, especially for the smaller ship lengths.

For Figures 22 to 30, the following comments are made:

1. Variations in GM do not affect acceleration responses, see Figures 23 to 28. Only roll response magnitude and period are affected.
2. Except for roll, the response envelopes are generally similar for each ship. Further, the maximum heave, pitch, lateral and vertical acceleration responses for the series occur within a relatively narrow period range of about 4 seconds. For example, for all 9 ship/load conditions maximum heave response occurs for periods

between 16.1 and 20.3 seconds. Similarly, for maximum pitch response the period range is 7.7 to 11.6 seconds. It is also important to note that the periods for maximum vertical acceleration responses always agree closely with the period for maximum pitch responses. As the pitch and vertical acceleration maxima occur near head seas, this infers that pitch motion is a major factor effecting vertical acceleration.

3. As expected, maximum roll responses occur for periods close to the estimated natural roll periods* of the ships, i.e., within 3 seconds.
4. Maximum vertical accelerations are two to three times larger than maximum lateral accelerations, depending on ship length. Furthermore, maximum longitudinal accelerations are at most one quarter of the value of maximum vertical accelerations. Maximum roll angles are at least twice as large as maximum pitch angles.
5. Vertical acceleration is much more sensitive to encountered modal period than either longitudinal or lateral acceleration.

APPLICATION OF RESULTS

The LNG ship response data base was developed for a specific application, i.e., to determine extreme ship responses and compare them with current classification rules used to design LNG cargo tanks. However, the data base can be used for other problems and three examples are given below. Only the first example is concerned with extreme ship responses and is taken from the Phase III work, see Reference 2.

Example 1

A building block procedure to determine design ship responses based on short-term statistics has been developed, see Reference 1. The procedure

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*Natural roll periods have been estimated by

$$T_\phi = 1.108\ K_\phi/\sqrt{GM}$$

and are given in Table 1 and Figure 1.

consists of four essentially independent steps. The first three steps produce a data base of ship responses in extreme seas. This data base is referred to as the extreme response data base and is defined by

$$X = \sigma \cdot (\tilde{\zeta}_w)_{1/3} \cdot C_T$$

where X is the extreme response. σ is the RMS response for unit significant wave height. $(\tilde{\zeta}_w)_{1/3}$ is the extreme significant wave height for a specified modal wave period T_o and geographic location. C_T is a so-called confidence factor which provides that the extreme response, X, is not to be exceeded by a specified probability, α, for a given exposure time, T, of the ship to the extreme seas. The fourth step of the building block procedure consists of selecting design values from this data base by applying rational ship operator strategies in storms. The strategies involve speed reduction, heading change to limit vessel motions, most likely headings, etc.

Reference 2 provides an application of this four step procedure to determine LNG tank design accelerations. In short, extreme response surfaces are developed for the LNG ship series from the RMS unit significant wave height surfaces of this report, see Figures 17 to 21. Worldwide measured or observed extreme wave heights are used and the extremes are predicted with a probability of one in a hundred of being exceeded during a one day ship exposure to the extreme seas. Figure 9 presents the selected design vertical accelerations when rational ship operator strategies are applied to the extreme vertical acceleration surfaces. The two dashed lines on the figure represent current classification rules for LNG tank design. The significance of this figure is further discussed in Reference 2.

Example 2

Together with oceanographic data for specific geographic areas, the RMS unit wave height response data base of this report can be used to determine the optimum ship course (least time) from a port of departure to a port of arrival. Such work, which considers the effect of various ship operator strategies, is now in progress at NSRDC, under USCG sponsorship, for a series of ammunition-carrying ships.

Example 3

Another application of the data base is the determination of accelerations at arbitrary points in the ship. The present data base, see Appendix D, includes accelerations at the forward tank center only. Figures 10 and 11 were prepared to enable the determination of accelerations at other points. Figure 10 defines the points in the five series ships for which special acceleration calculations, shown in Figure 11, were done. Figure 11 demonstrates the effect of spatial variations within the ship on the predicted RMS unit wave height accelerations, which are denoted on the figure by $L_{\ddot{V}}$ for vertical, $L_{\ddot{A}}$ for lateral, and $L_{\ddot{O}}$ for longitudinal. A modal wave period, T_o, of 13 seconds was used for the calculations. Figure 11a presents results for the base load conditions of the five series ships in bow seas. Similarly, Figure 11b presents the bow sea results for the alternate load conditions of Ships B and C. Figures 11c and 11d present results for all load conditions of Ship C in beam and quartering seas. Three types of point variation are demonstrated.

The bottom row of graphs on Figure 11 shows the differences in predicted vertical and lateral accelerations across the LNG ship series when the position along the ship varies longitudinally. For example, in the lower left hand corner of Figure 11a, the vertical scale is for vertical acceleration, $L_{\ddot{V}}$, and values are shown for Ship A at point 1, the center of the forward tank, point 4, midships, and point 5, the center of the last tank, see Figure 10. The abscissa scale, used to denote the position of points 1, 4, and 5 along the ship, denotes the ship length from the aft perpendicular, AP, to the forward perpendicular, FP. Values for both 10 knots (solid line) and 20 knots (dashed line) are shown. To the immediate right of this plot is the corresponding plot for lateral acceleration, $L_{\ddot{A}}$, for Ship A.

Similarly, the middle row of graphs on Figure 11 shows the differences in predicted vertical and longitudinal accelerations when the position on the ship varies laterally. Values for point 1 and for point 3, which is to the port side of the forward tank center, are shown. The abscissa scale is for 100 feet on each side of midships, ⊅ , where a negative sign indicates the port side of the ship.

Finally, the top row of plots of Figure 11 shows the differences in predicted lateral and longitudinal accelerations when the position on the ship varies in the vertical direction. Values for point 1 and for point 2, which is below the center of the forward tank, are shown. The abscissa scale is for distance in feet above the baseline where 0 denotes the baseline.

Several general comments regarding the effects of spatial variation on ship accelerations are to be noted. Firstly, vertical acceleration is constant along any vertical line through the ship. For example, vertical acceleration is the same for points 1 and 2 defined on Figure 10. Similar rules hold for lateral and longitudinal accelerations, see Equation 12 which defines ship responses at any point along the ship. Secondly, only large spatial variations, such as are possible in the longitudinal direction, drastically alter the predicted accelerations, see Figure 11. Thirdly, neither speed variations nor load (GM) variations affect acceleration trends with spatial variations for a specific heading, though the trends do vary substantially for different headings, see Figure 11.

Acceleration values at points other than the forward tank can be estimated from the data base of Appendix D by using the trends of Figure 11. For example, suppose the vertical acceleration of the aftmost tank for the case where the forward tank acceleration is maximum is requried for Ship A at 10 knots. From Table 8, the maximum vertical acceleration at 10 knots occurs at 135 to 150 degrees at an 11 second modal wave period and is 0.0044 g. From Figure 11a, the vertical acceleration of the aft tank is 78 percent (0.0032/0.0041 = 0.78) that of the forward tank.* Therefore, the acceleration in the aft tank corresponding to the maximum vertical acceleration of the forward tank at 10 knots is 0.0034 g (0.78 x 0.0044 g = 0.0034 g).

A final comment is made in connection with Example 1. It may be assumed that the extreme accelerations, and hence the selected design accelerations, vary for different tanks in the ship by the same trends as shown in Figure 11.

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*It should be noted that the acceleration is minimum at midships and maximum at the bow. From Figure 11a, the vertical acceleration at midships is 61 percent that at the bow (0.0025/0.0041 = 0.61) for Ship A.

Thus, the tank at midships may have a smaller design acceleration value than the tank nearest the bow which has the maximum value.

CONCLUDING REMARKS

The LNG ship series response data base presented in this report is applicable to ship design/naval engineering problems. Examples of applications to several such problems have been given. Though the data base was developed primarily for determining extreme accelerations of LNG cargo tanks, it is not limited to such use. In fact, it is expected that in the future, when LNG Carriers are employed to transport denser cargoes than liquid natural gas, the response data base presented herein will still be applicable as long as design displacement/load conditions are maintained.

A major feature of the data base is that the ship responses are defined for one foot significant wave height two-parameter sea spectra. This permits simple scaling of the so-called unit wave height ship responses to arbitrary wave heights for specified modal wave periods. As more and more oceanographic data becomes available, it is expected that changes will occur for observed and measured extreme wave height and modal wave period combinations, as used to determine design accelerations in Reference 2. The LNG ship unit wave height response data base, stored on a digital magnetic tape, can be easily applied as new extreme wave data become available.

Another more basic feature of the data base is that the wide range of speeds, headings, and modal periods covers all conceivable values of these variables. Thus, it is considered that the ship response data base represents the range of all possible, physically realizable ship responses.

In conclusion, it is considered important to note that the seakeeping performance of any existing ship class or new ship class* can be rationally evaluated by constructing the type of data base presented in the present report. Of course, the type of ship responses considered important might differ from the ones presented in this report for LNG Carriers.

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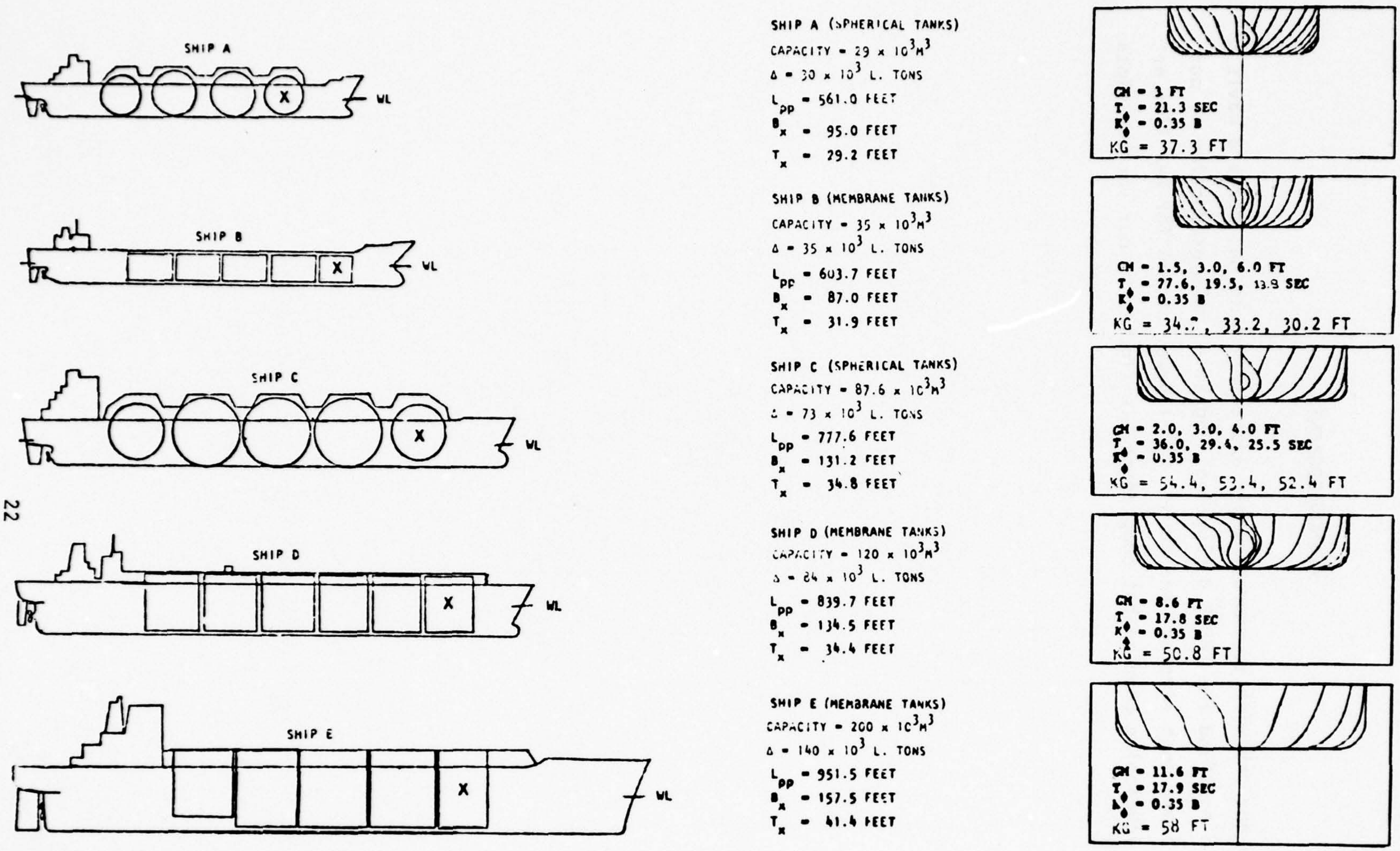
*With hull forms similar to the LNG ships or hull forms for which the basic ship response prediction accuracies have been established.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to Ms. Barbara Davis of NSRDC who modified the THREE D plotting program to make production of our surface plots much simpler, and to Ms. Carol Dewey of NUS for her fine art work in developing concise but comprehensible figures of our surface plots.



NOTES: 1. X IS LOCATION OF CENTER OF FORWARD TANK FOR WHICH SHIP ACCELERATIONS ARE PREDICTED.
2. SHIP PROFILES ARE NOT TO SAME SCALE AS SHIP BODY PLANS.
3. T_ϕ IS APPROXIMATE ROLL PERIOD. K_ϕ IS ROLL RADIUS OF GYRATION.

Figure 1 - LNG Series Ship Particulars and Geometry

CALCULATION PROCEDURE

A. SHIP GEOMETRY, OPERATING CONDITIONS →

NSRDC SHIP MOTION AND SEA LOAD COMPUTER PROGRAM*

1. USING STATE OF ART THEORY, REFERENCE 5, COMPUTE SIX DEGREE OF FREEDOM RAOs (AT ORIGIN)

B. SIX DEGREE OF FREEDOM RAOs (AT ORIGIN), SEA CONDITIONS →

NSRDC IRREGULAR SEA RESPONSE PREDICTION PROGRAM**

1. MODIFY SURGE, SWAY AND YAW RAOs NEAR $\omega_E = 0$
2. COMPUTE ACCELERATION RAOs AT CENTER OF FORWARD TANK
3. APPLY ROLL CORRECTION FACTOR WHERE APPLICABLE
4. COMPUTE SHORT CRESTED TWO-PARAMETER WAVE SPECTRA WITH 1 FOOT SIGNIFICANT WAVE HEIGHT
5. COMPUTE SHORT CRESTED ENCOUNTERED RESPONSE SPECTRA
6. COMPUTE RMS RESPONSES, σ
7. COMPUTE ENCOUNTERED MODAL RESPONSE PERIODS, T_{OE}

* Reference 4 Provides a Users' Guide for this Program

** This Program is Actually a Series of Programs and is not yet Formally Documented

Figure 2 - Calculation Procedure for RMS Ship Response Data Base

SHIP A - 10 KNOTS - PREDICTED RESPONSE AMPLITUDE OPERATORS

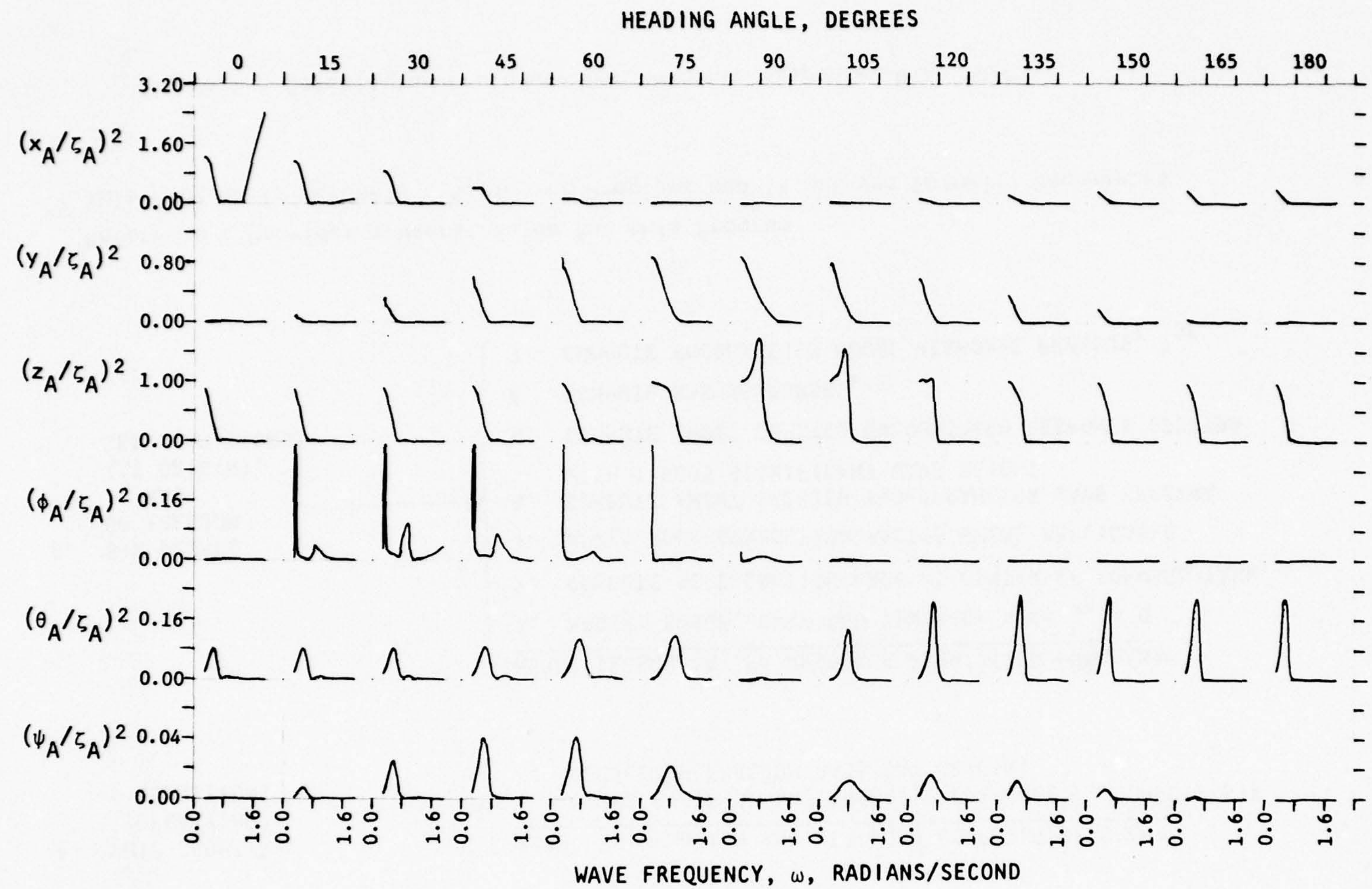


Figure 3 - Typical Response Amplitude Operators

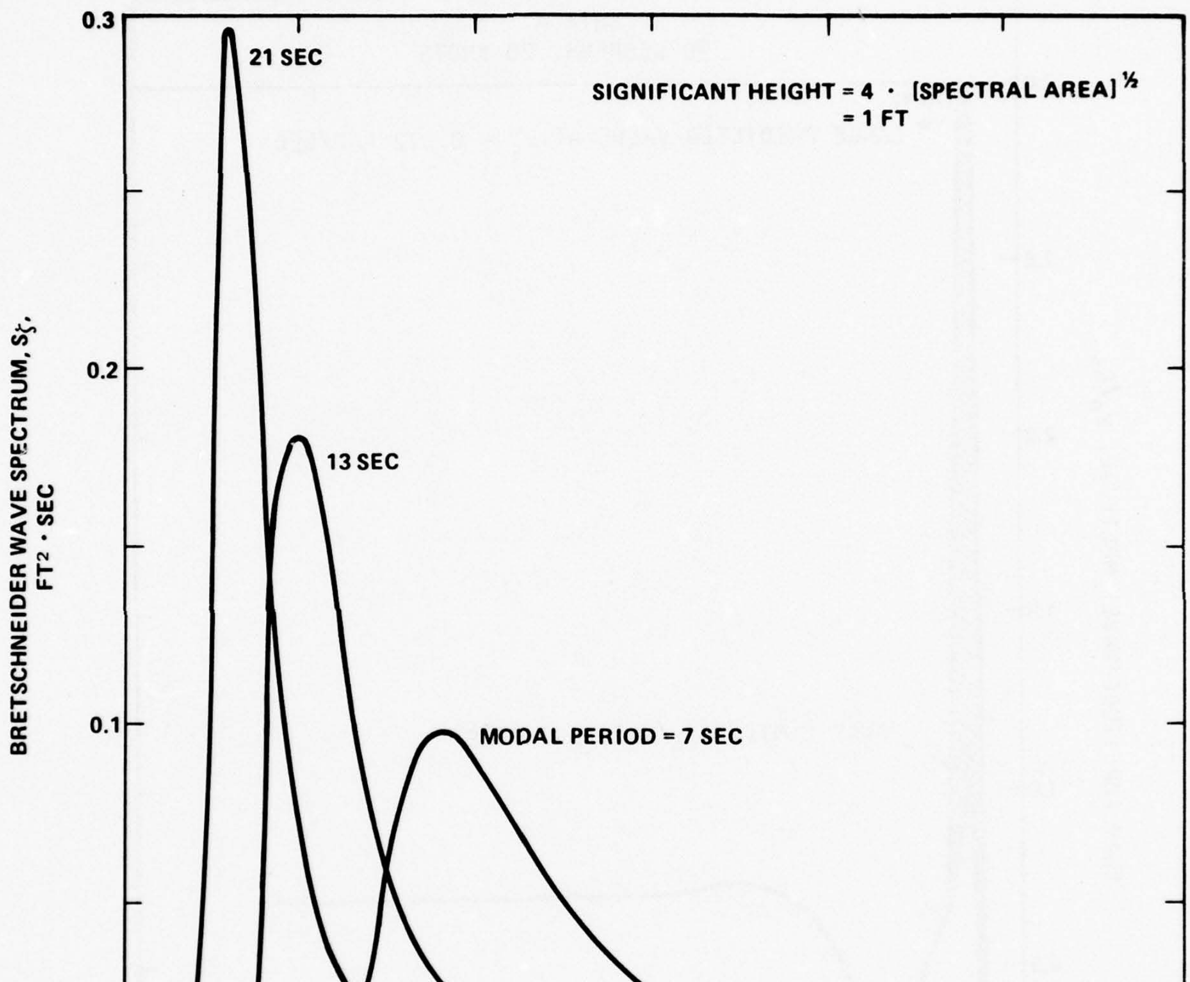


Figure 4 - Bretschneider Two-Parameter Spectral Family

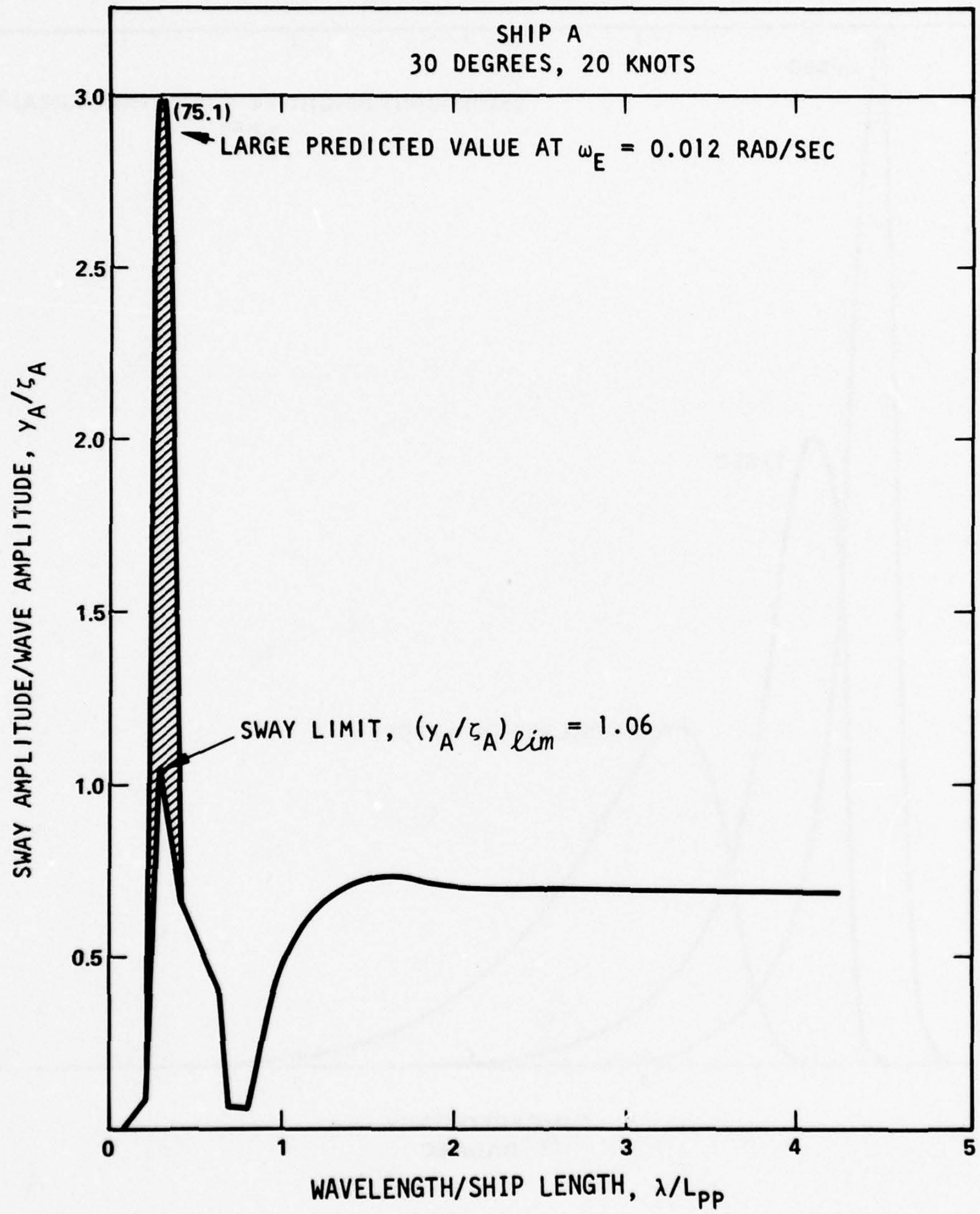


Figure 5 - Typical Occurrence and Fix of Large Ship Motion Prediction for Near Zero Wave Encounter Frequency, ω_E

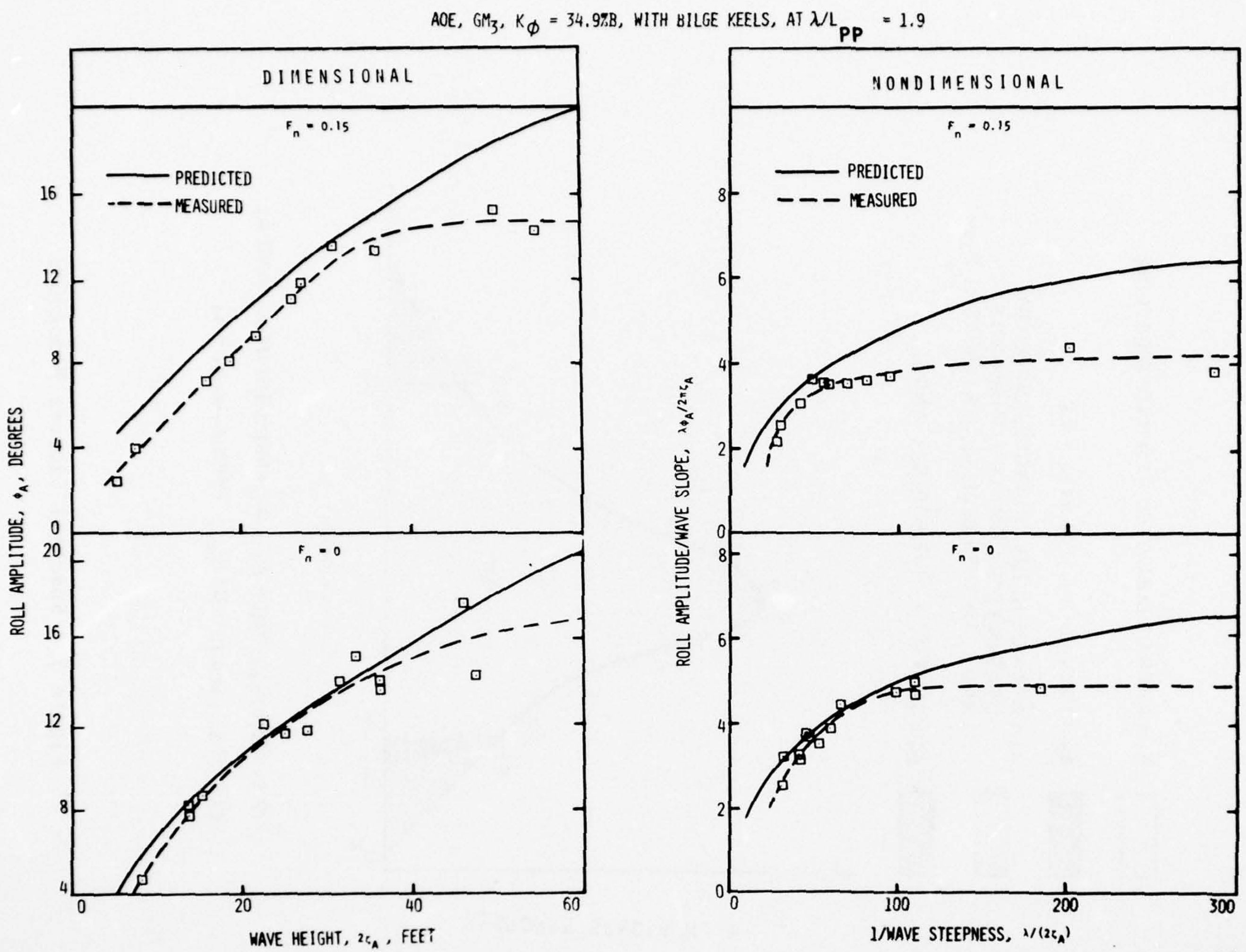
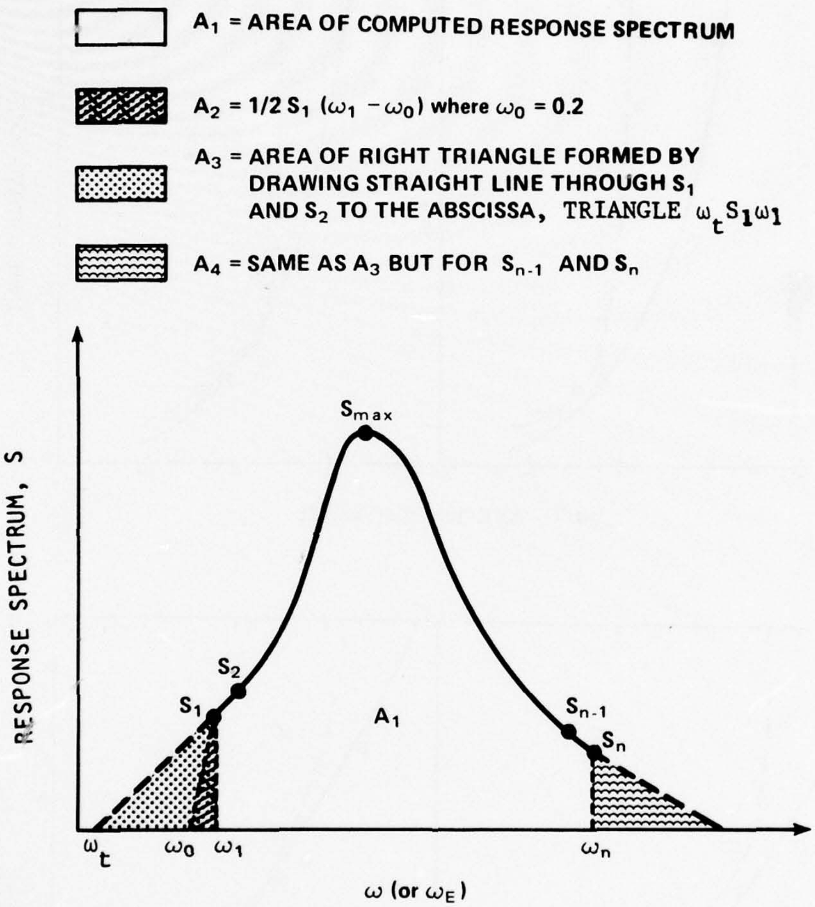


Figure 6a - Roll Amplitude versus Wave Height

Figure 6b - Roll Amplitude/Waveslope versus 1/Wave Steepness

Figure 6 - Comparison Between Measured and Predicted Roll Nonlinearities of a Typical Naval Oil Tanker at Resonance in Beam Waves



IF $S_1 > 0.1\, S_{max}$, THEN $A_1 \leftarrow A_1$ + MINIMUM OF A_2 AND A_3.

IF $S_n < S_{n-1}$ and $S_n > 0.1\, S_{max}$, THEN $A_1 \leftarrow A_1 + A_4$.

Figure 7 - Spectral Closure Procedure

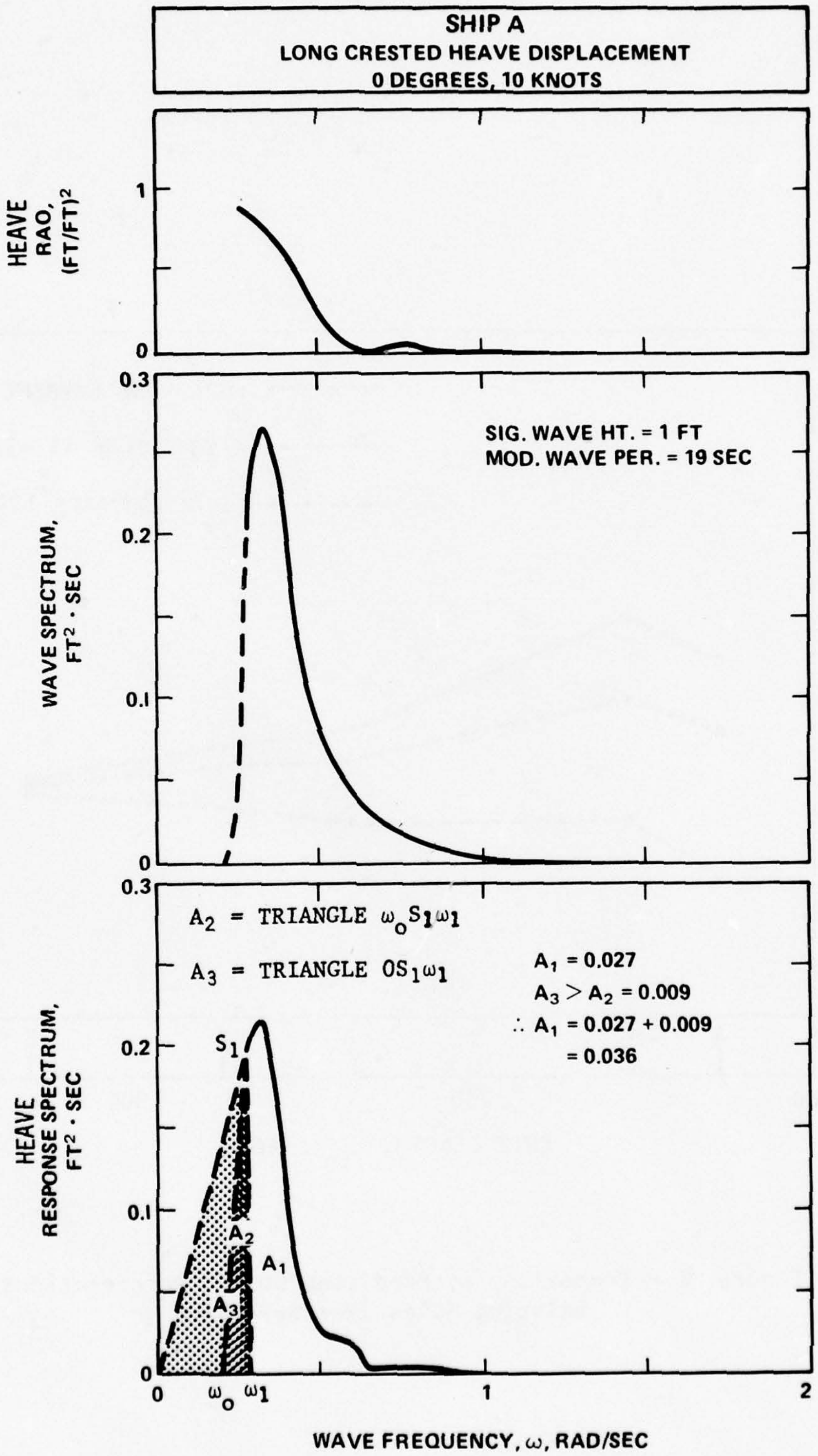


Figure 8 - Application of Spectral Closure Procedure described in Figure 7

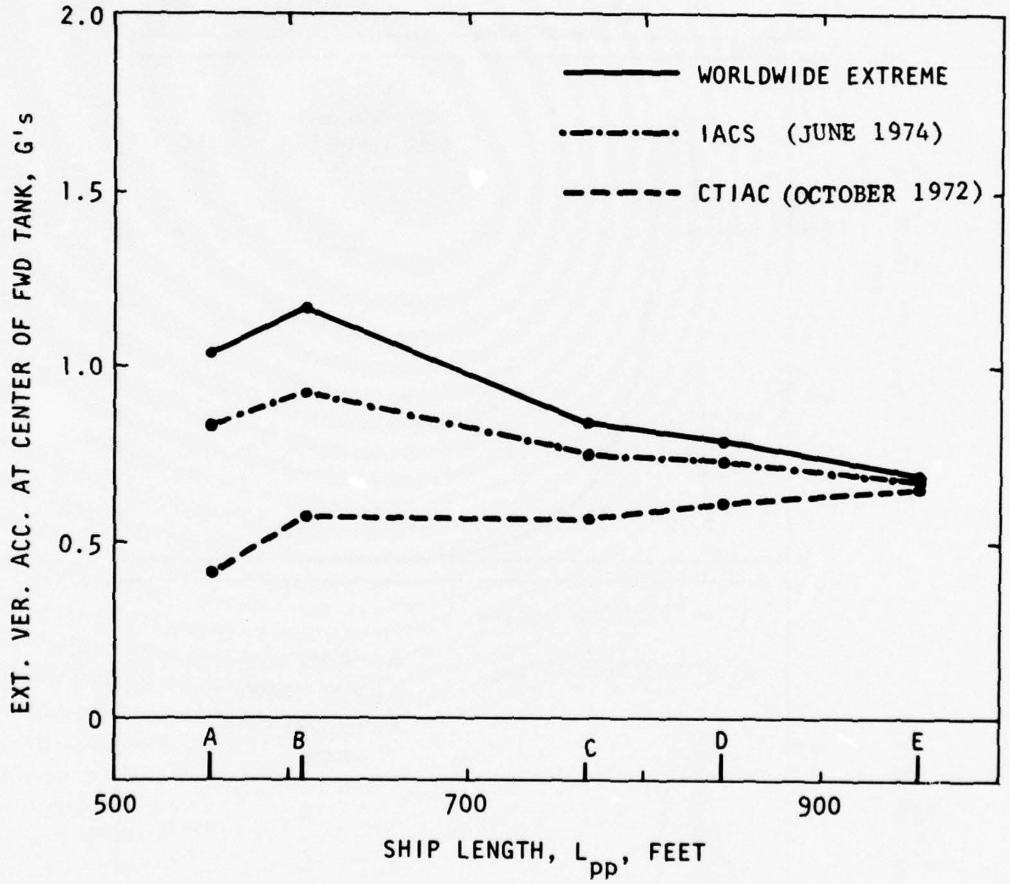


Figure 9 - Comparison of Predicted Design Accelerations with Existing Rules from Reference 2

SHIP	POINT	DESCRIPTION	LONGITUDINAL DISTANCE FROM AFT PERPENDICULAR (FEET)	LATERAL DISTANCE FROM CENTERLINE AXIS (FEET)	VERTICAL DISTANCE FROM BASELINE (FEET)
A	1	Center of Forward Tank	422.6	0.	46.6
	2	Above Bottom of Forward Tank, Below Center of Tank	422.6	0.	11.5
	3	To Side of Center of Forward Tank	422.6	-38.95	46.6
	4	Midships	280.5	0.	46.6
	5	Center of Last Tank	151.1	0.	46.6
B	1	Center of Forward Tank	510.8	0.	35.3
	2	Above Bottom of Forward Tank, Below Center of Tank	510.8	0.	7.92
	3	To Side of Center of Forward Tank	510.8	-34.3	35.3
	4	Midships	301.9	0.	35.3
	5	Center of Last Tank	172.9	0.	35.3
C	1	Center of Forward Tank	633.05	0.	47.8
	2	Above Bottom of Forward Tank, Below Center of Tank	633.05	0.	15.0
	3	To Side of Center of Forward Tank	633.05	-54.2	47.8
	4	Midships	388.8	0.	47.8
	5	Center of Last Tank	172.8	0.	47.8
D	1	Center of Forward Tank	708.7	0.	53.7
	2	Above Bottom of Forward Tank, Below Center of Tank	708.7	0.	16.7
	3	To Side of Center of Forward Tank	708.7	-25.0	53.7
	4	Midships	419.8	0.	53.7
	5	Center of Last Tank	215.0	0.	52.0
E	1	Center of Forward Tank	809.9	0.	62.0
	2	Above Bottom of Forward Tank, Below Center of Tank	809.9	0.	15.8
	3	To Side of Center of Forward Tank	809.9	-46.5	62.0
	4	Midships	475.7	0.	62.0
	5	Center of Last Tank	216.3	0.	62.

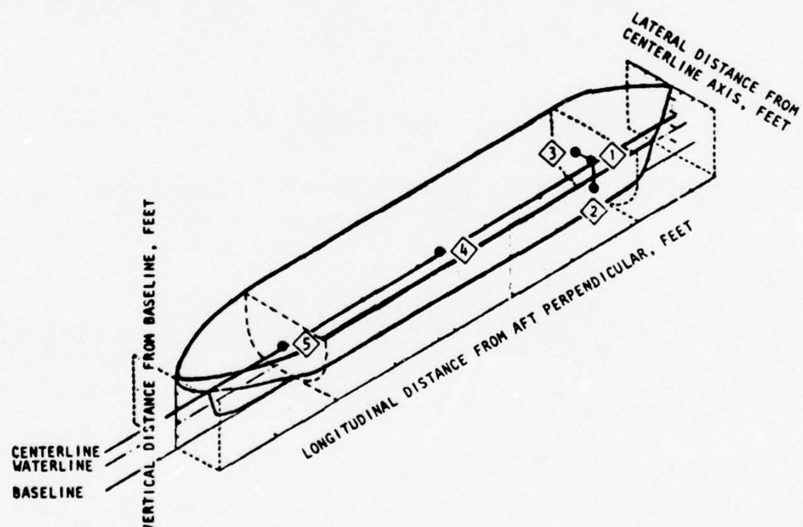


Figure 10 - Point Location for Prediction of Accelerations for LNG Ship Series

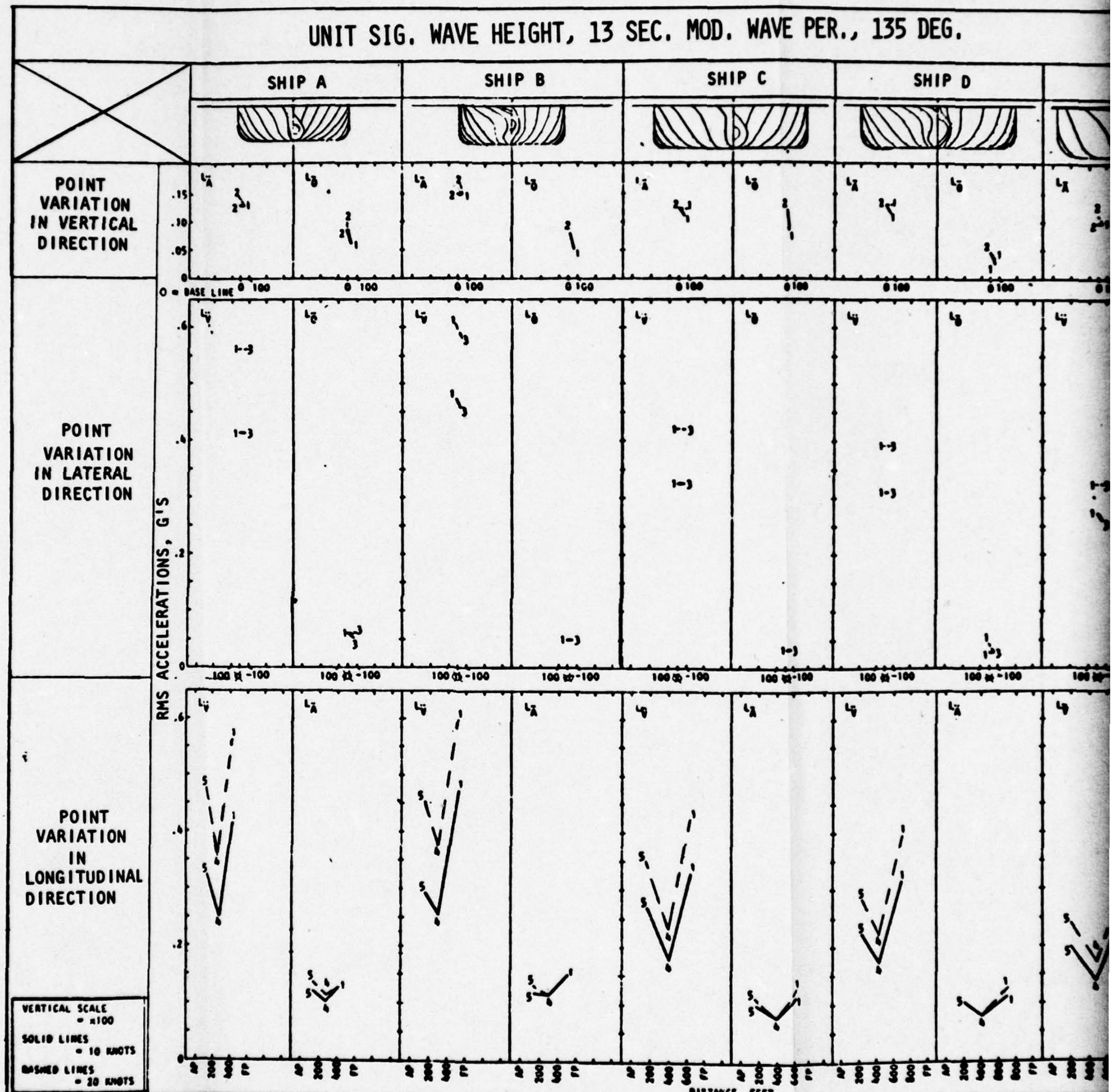


Figure 11a - Five Series Ships. Base Load Conditions, Bow Seas

Figure 11 - Influence of Spatial Variation Within Ship on LNG Ship Series Acceleration Predictions

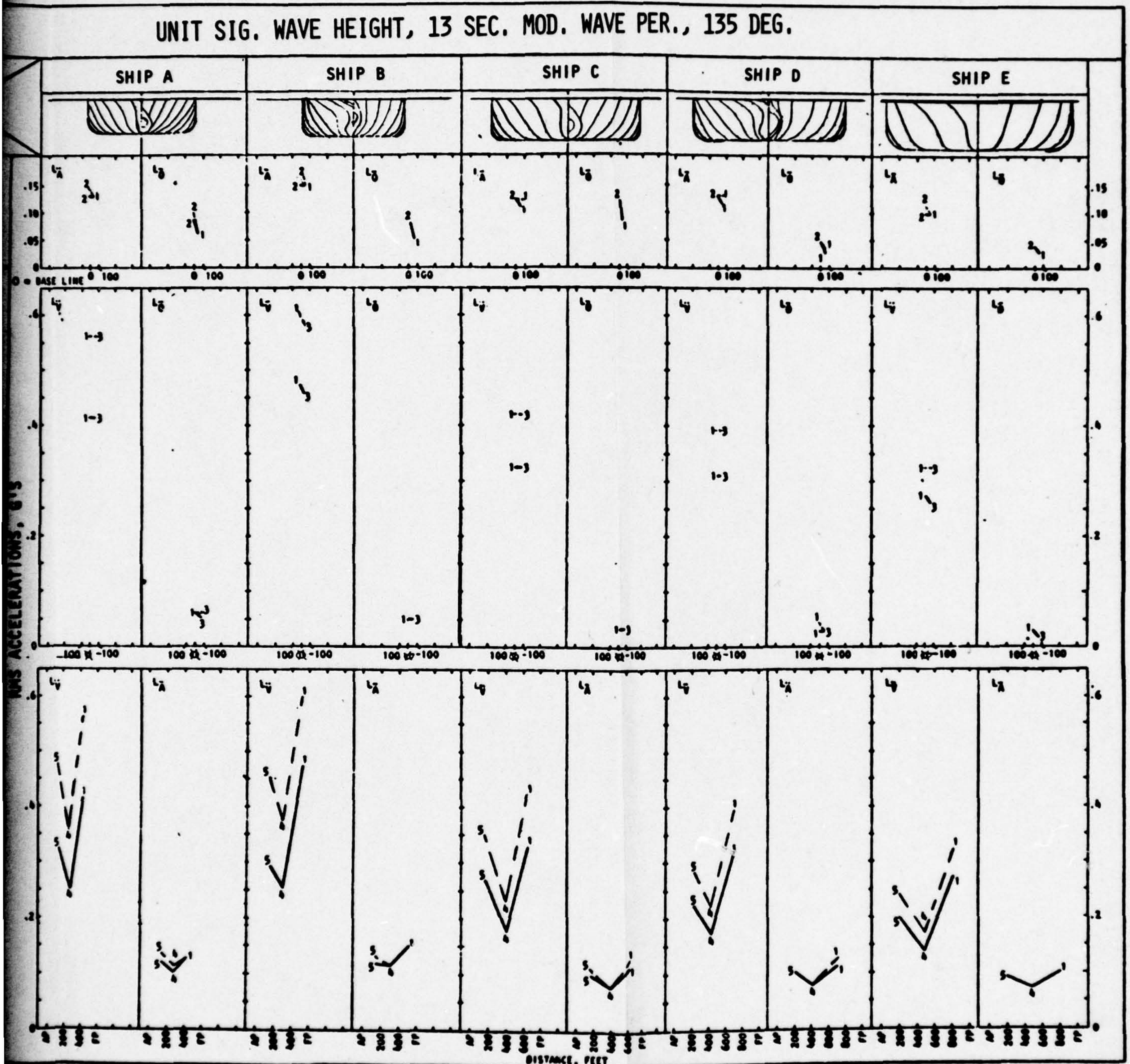


Figure 11a - Five Series Ships. Base Load Conditions, Bow Seas

Figure 11 - Influence of Spatial Variation Within Ship on LNG Ship Series Acceleration Predictions

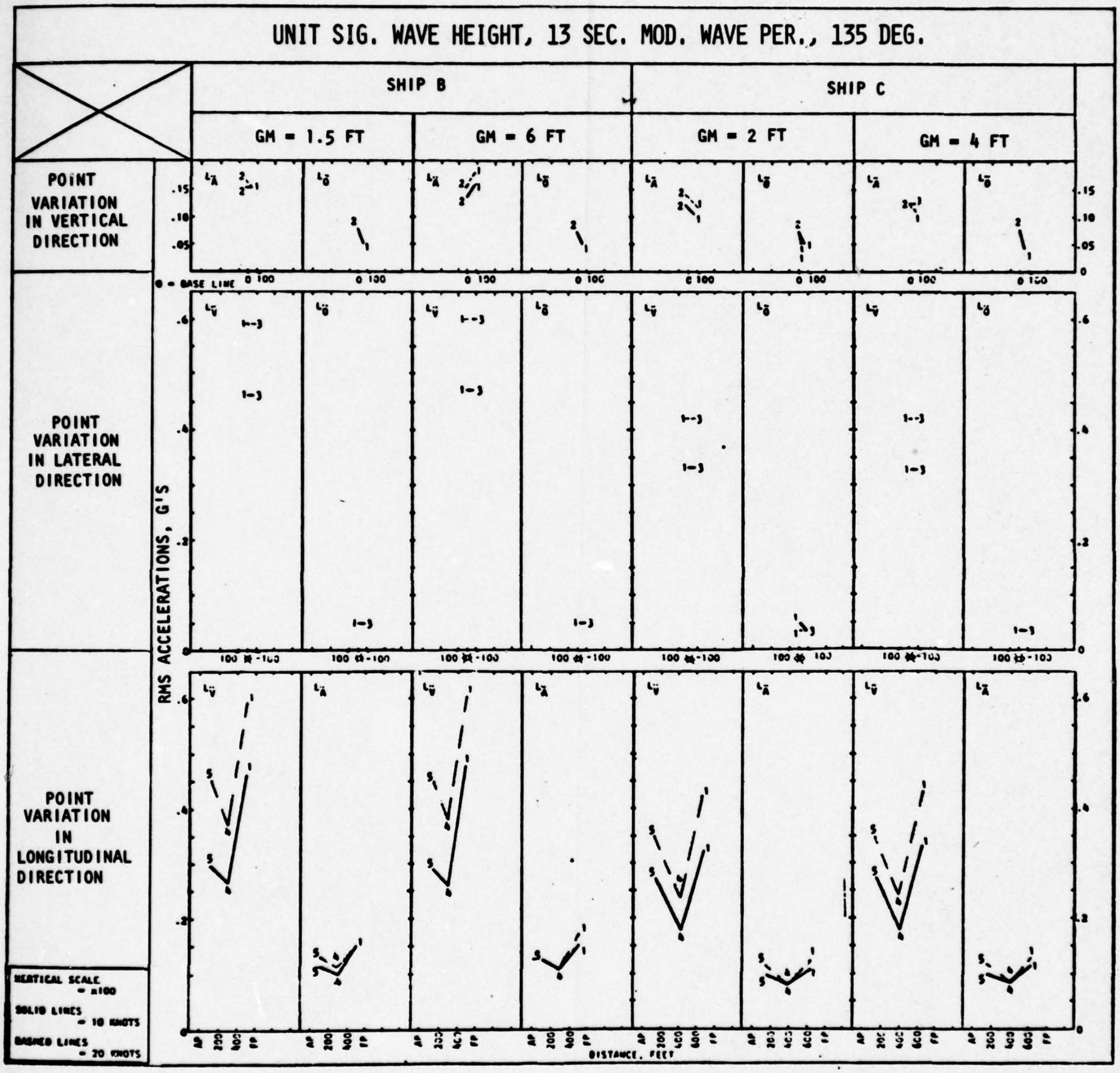


Figure 11b - Ships B and C, Alternate Load Conditions, Bow Seas

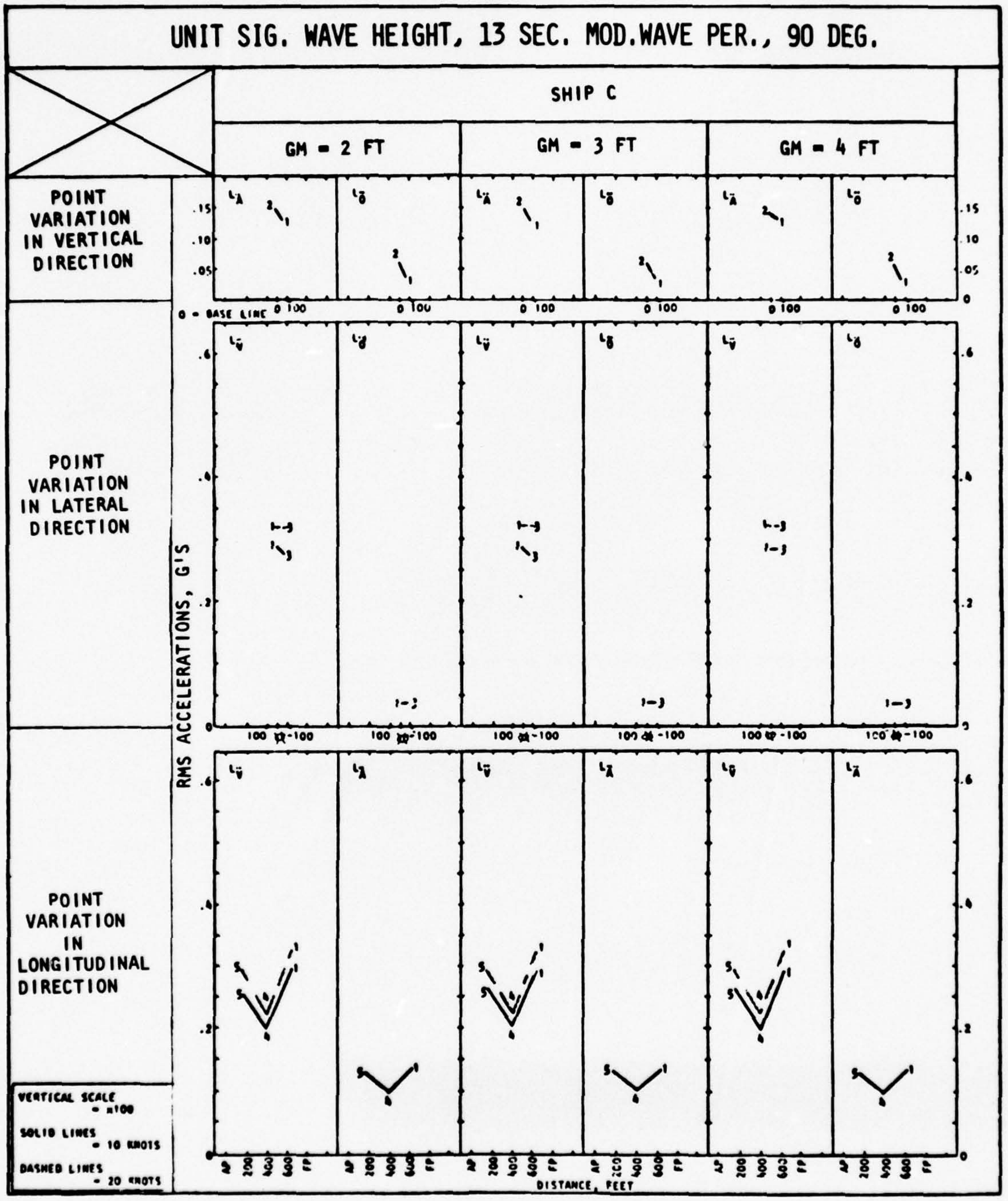


Figure 11c - Ship C, All Load Conditions, Beam Seas

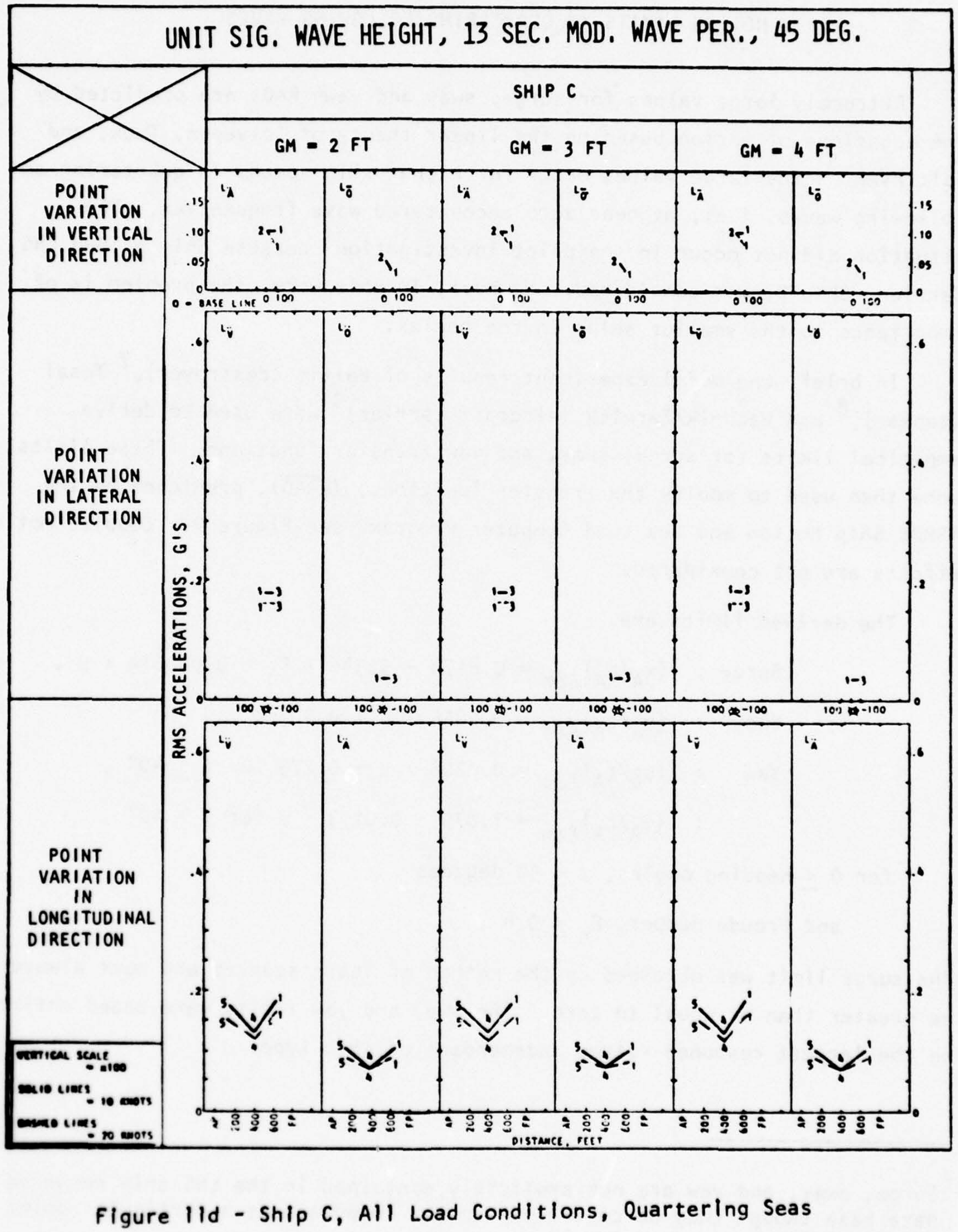


Figure 11d - Ship C, All Load Conditions, Quartering Seas

APPENDIX A

MOTION LIMITS IN QUARTERING/FOLLOWING WAVES

Extremely large values for surge, sway and yaw* RAOs are predicted by the equations of motion based on the linear theory of Salvesen, Tuck, and Faltinsen.[5] The large values occur for higher ship speeds in quartering and following waves, i.e., at near zero encountered wave frequencies. The situation did not occur in the pilot investigation[1] because only a long LNG Carrier, Ship D, was considered. However, in this work, the problem is of importance to the smaller ships in the series.

In brief, the model experiment results of Baitis (destroyer),[7] Tasai (tanker),[8] and Wachnik/Zarnick (aircraft carrier)[9] were used to derive empirical limits for surge, sway, and yaw transfer functions. These limits were then used to modify the transfer functions, $(\sqrt{RAO})$, predicted by the NSRDC Ship Motion and Sea Load Computer Program, see Figure 2. Coupled motion effects are not considered.

The derived limits are

$$\text{Surge} : (x_A/\zeta_A)_{\ell im} = 0.8174 + 5.946 \cdot F_n - 0.020614 \cdot \mu ,$$

$$\text{Sway} : (y_A/\zeta_A)_{\ell im} = 0.0255 \cdot \mu + 0.3 ,$$

$$\text{Yaw} : (\psi_A/\zeta_A)_{\ell im} = 0.0206 \cdot \mu + 0.275 \text{ for } \mu \leq 40° ,$$

$$: (\psi_A/\zeta_A)_{\ell im} = 1.875 - 0.0193 \cdot \mu \text{ for } \mu > 40° ,$$

for $0 \leq$ heading angles, $\mu \leq 90$ degrees

and Froude number, $F_n \leq 0.4$.

The surge limit was obtained by the method of least squares and must always be greater than or equal to zero. The sway and yaw limits were based entirely on the largest response values independent of ship type.

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*Surge, sway, and yaw are not explicitly contained in the LNG ship response data base though they do contribute to the responses at a particular point along the ship, see equation 12.

Figure 12 shows the limits along with the extreme data on which they are based. It is noteworthy that only surge appears to be speed dependent whereas all three responses are strongly dependent on ship heading relative to the seas.

Figure 5 presents a typical application of the procedure to a sway transfer function in quartering waves. For this heading, 30 degrees, the empirically derived sway limit, $(y_A/\zeta_A)_{\ell im}$, is 1.06. Therefore, the computed sway transfer function is limited by this value, e.g., the large computed value $y_A/\zeta_A = 75.1$ is reduced to $y_A/\zeta_A = 1.06$.

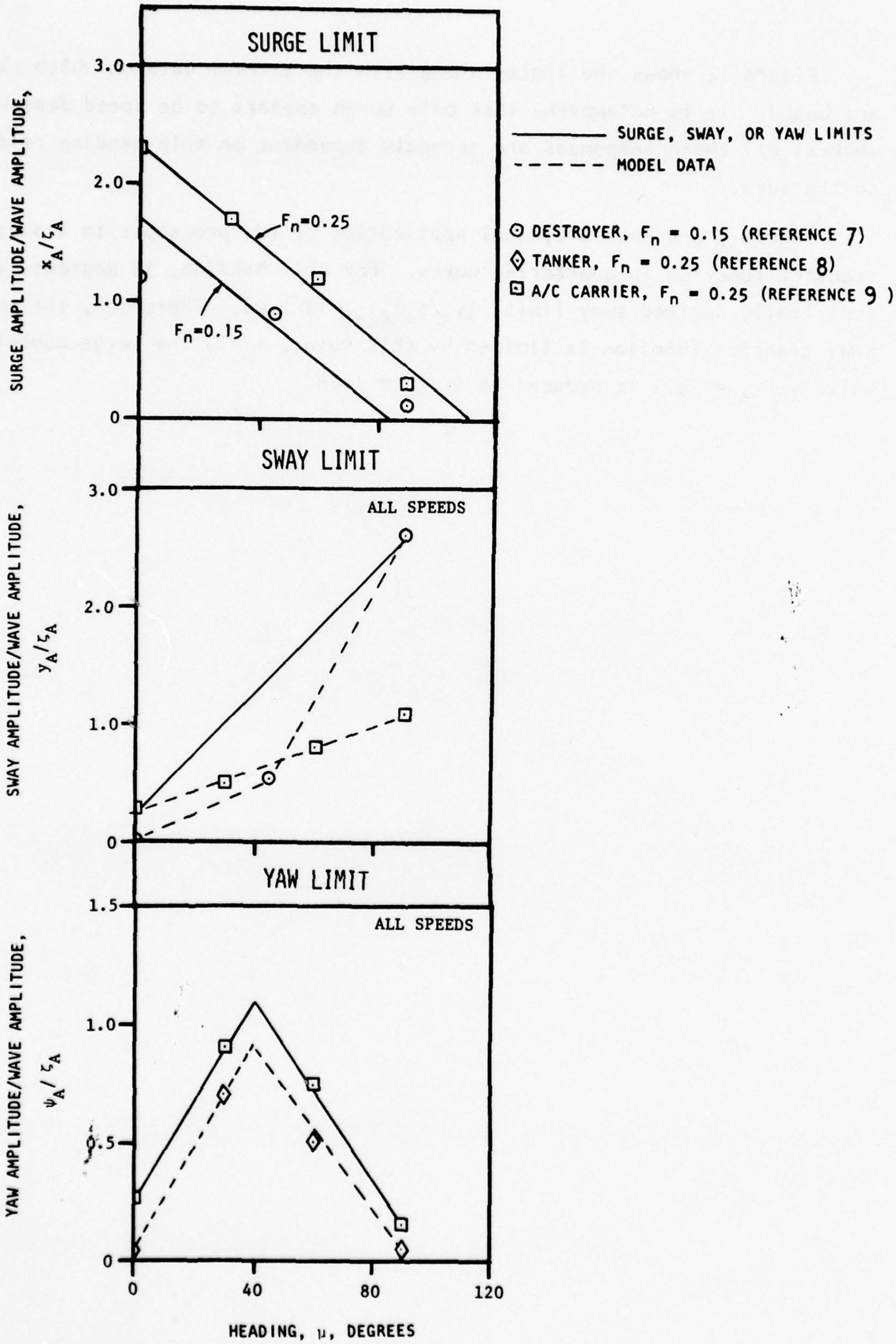

Figure 12 - Extreme Surge, Sway, and Yaw Limits at Near Zero Frequencies of Encounter and the Associated Model Data

APPENDIX B

ROLL CORRECTION FACTOR

Ship response predictions are usually made by assuming the responses to be linear with wave height. Roll is considered to be the most nonlinear ship response for the conventional monohulls under examination in this report. Thus, roll nonlinearities, and their effect on the predicted RMS roll angles, are of importance to this work.

The linearity assumption departs from reality for high wave heights as shown for roll motion in Figure 6, which is taken from unpublished NSRDC model experiment results. Also shown on the figure are the corresponding roll responses predicted by linear theory.[5] Clearly, in Figure 6a, the predicted roll amplitudes are too large for higher wave heights, i.e., wave heights exceeding 30 feet. Furthermore, Figure 6b, which presents the data of Figure 6a in nondimensional form, shows that roll amplitude per unit wave height (actually wave slope) is reduced as 1/wave steepness decreases (or as wave steepness increases and wave height increases). The measured roll amplitudes per unit wave slope are essentially linear for wave steepnesses less than 1/80 (or 1/wave steepness greater than 80). At greater steepnesses, the measured roll rapidly becomes nonlinear. The use of greater steepnesses (or higher wave heights) is of foremost concern in this work because the primary purpose of the RMS unit wave height response data base is to predict LNG ship responses in extreme seas. Figure 6 clearly shows that roll is overpredicted for the higher, steeper waves.

Therefore, a so-called roll correction factor for these extreme waves has been developed to prevent predicted roll in extreme seas from being excessively conservative, i.e., large. This factor is equal to the ratio of roll at resonance in waves of 1/20 steepness divided by the roll at resonance in waves of 1/80 steepness.* The factor was established for a large number

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*Predicted roll and measured roll, at resonance, have been shown to agree reasonably well, over a range of speeds, for wave steepnesses of 1/80, see Reference 6.

of ship headings and speeds and it was found that the roll predictions at 1/80 steepness are valid (the roll correction factor approaches 1) for all but headings from 0 to 90 degrees and speeds of 15 and 20 knots. For these cases, the factor was constant across heading and decreased with increased speed. For 15 knots the factor is 0.73 and for 20 knots is 0.53. The factor is applied to the predicted RMS roll angles of the data base of this report because the data base is primarily intended for future prediction of extreme sea ship responses.

APPENDIX C

VALIDATION OF PERIODS ASSOCIATED WITH EXTREME RESPONSES USING FULL-SCALE AND SIMULATION DATA

Since some of the proposed regulations regarding LNG tank design accelerations are written in terms of both the locations in the ship as well as the ship's natural roll, pitch and heave periods, the USCG repeatedly inquired as to procedures by which the periods could be associated with extreme or design accelerations. In a recent Navy sponsored project, the modal encountered period was shown to be related directly to the maximum ship responses. This relationship was established by demonstrating that the zero crossing period associated with the maximum response cycle corresponds closely, i.e., within about $\pm$ 10 percent, to the encountered modal period, T_{OE}. (T_{OE} refers to the period corresponding to the peak of the encountered response spectrum.) The Navy project represented the first time such a correlation between maximum response and associated period had been established at NSRDC. Thus, it was essential to further validate the relationship before adopting it for use in the development of LNG tank design accelerations. Two validation investigations were undertaken:

1. Verify the relationship by examining predicted response time histories.
2. Verify the relationship by examining full-scale trial response time histories.

The initial Navy work used predicted time histories for long crested (uni-directional) wind waves with swell superimposed at various specified angles. For the LNG project, this validation investigation has been performed by improving the realism of the wind wave representation to short crested (multi-directional) seas. Responses were computed in both time history and spectral form.

The short crested time histories were simulated from the work of Zarnick[10] as

$$s(t) = \sum_{j}^{M} \sum_{k}^{N} b_j \cdot s_k \cdot \cos(\omega_k t + \gamma_{jk}) \tag{14}$$

where

$$s_k = [2 \int_{\omega_k - \Delta\omega/2}^{\omega_k + \Delta\omega/2} S_\zeta(\omega)\, d\omega]^{\frac{1}{2}} \tag{15}$$

and s(t) is the wave time history, b_j is a factor for angular spreading of the wave energy (assumed independent of the wave frequency), γ_{jk} is the random phase angle associated with the heading angle and the wave frequency, M is the number of discrete heading angles, and N is the number of discrete wave frequencies.

A cosine squared function is used to spread the wave energy from long crested to short crested seas, i.e.,

$$b_j = \frac{2}{\pi} \int_{\chi_j - \Delta\chi/2}^{\chi_j + \Delta\chi/2} \cos^2 \chi_j \, d\chi \tag{16}$$

where χ_j is the wave direction relevant to the predominant direction. The response time history, r(t), is

$$r(t) = \sum_{j}^{M} \sum_{k}^{N} R_{Ak} \cdot b_j \cdot s_k \cdot \cos(\omega_{Ek} t + \gamma_{jk} - \varepsilon_k) , \tag{17}$$

where R_{Ak} and ε_k are the amplitude and phase of the frequency response functions at ω_{Ek}.

Figure 13, adopted from Reference 2, presents typical simulated correlated wave height and ship motion time history segments. The simulation was done for a 30 minute ship exposure to the extreme seas and the motion segments shown in the figure are for the period of time in which the maximum vertical acceleration cycle occurs. The zero crossing period of the maximum acceleration cycle is designated as T_{MAX} on the figure. The encountered modal period derived from the peak of the acceleration spectrum is designated as T_{OE}. It is readily seen from this typical example that T_{OE} may be regarded as a good

estimator of T_{MAX}. For example, the vertical acceleration, which is considered the most important of the three accelerations, see Reference 2, has T_{MAX} estimated by T_{OE} to within 10 percent of its true value. The longitudinal acceleration is estimated with similar accuracy. The lateral acceleration T_{MAX} is estimated to within 20 percent of its true value.

The second validation investigation consisted of the re-analysis of four days of full-scale trial ship motion data. Ship speeds varied from about 2 to 27 knots and headings varied from head to following seas. Sea states varied from a low sea state 3 to a low sea state 5. A detailed examination of the measured data indicates that the modal encounter period, T_{OE}, does not predict the true period, T_{MAX}, as well as was indicated in the predicted time histories. Predicted time histories generally resulted in T_{OE} estimating T_{MAX} to within 10 percent. However, T_{OE} for the vertical acceleration estimated T_{MAX} to within $\pm$ 10 percent only about 57 percent of the time, though 95 percent of the time T_{MAX} was estimated to within $\pm$ 20 percent. Thus, T_{OE} estimated T_{MAX} reasonably well for the most important acceleration, i.e., for LNG tank design, 95 percent of the time. This estimate is valid even when T_{OE} values for other, less important, ship response variables do not necessarily predict the T_{MAX} associated with their respective maximum responses.

Figures 14 and 15 illustrate response spectra and their corresponding T_{OE} and T_{MAX} values for two specific full-scale trial conditions. Figure 14 represents a typical case where T_{OE} accurately estimates T_{MAX} for all ship response variables. Figure 15 illustrates a typical case where T_{OE} fails to estimate T_{MAX} accurately for all ship responses. However, in this latter case, even though pitch, roll, lateral and longitudinal accelerations as well as vertical stern motion do not have their respective T_{MAX} predicted to within the $\pm$ 20 percent tolerance, T_{OE} does accurately predict T_{MAX} for vertical acceleration. It is considered likely that the apparent failure of T_{OE} to predict T_{MAX} is related to the presence of swell in the seas and in particular is associated with the angle between the wind sea and the swell. This conclusion is substantiated in part upon examination of the wave spectra

that were measured in conjunction with Figures 14 and 15, see Figure 16.* The wave spectrum of Figure 16a, measured about one hour prior to the ship motions of Figure 14, shows one predominant peak which is due to the local wind driven sea. However, the spectrum of Figure 16b measured about two hours after the ship motions of Figure 15, shows two major peaks which indicates the presence of swell with the local wind driven sea. It is this presence of several major frequency components in the sea that appears to cause the failure of T_{OE} to estimate T_{MAX} in Figure 15.

In summary, it has been shown that T_{OE}, the encountered modal period of the response spectrum, is generally a reasonable estimator of T_{MAX}, the period of the maximum response cycle, for cases where the seaway is represented by an energy spectrum that is single peaked such as a Bretschneider spectrum, see Figure 4, or a measured sea spectrum such as in Figure 16a. For cases where the seaway contains large amounts of energy at several distinct frequency ranges, e.g., see Figure 16b, T_{OE} does not appear to be a valid estimator of T_{MAX}. Further investigation of the relationship between T_{OE} and T_{MAX} will be done as more full-scale ship response and wave height data become available.

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*It is considered that these spectra, though not measured simultaneously with the ship motions of Figures 14 and 15, show the general characteristics of the seas at the times that the motions were measured.

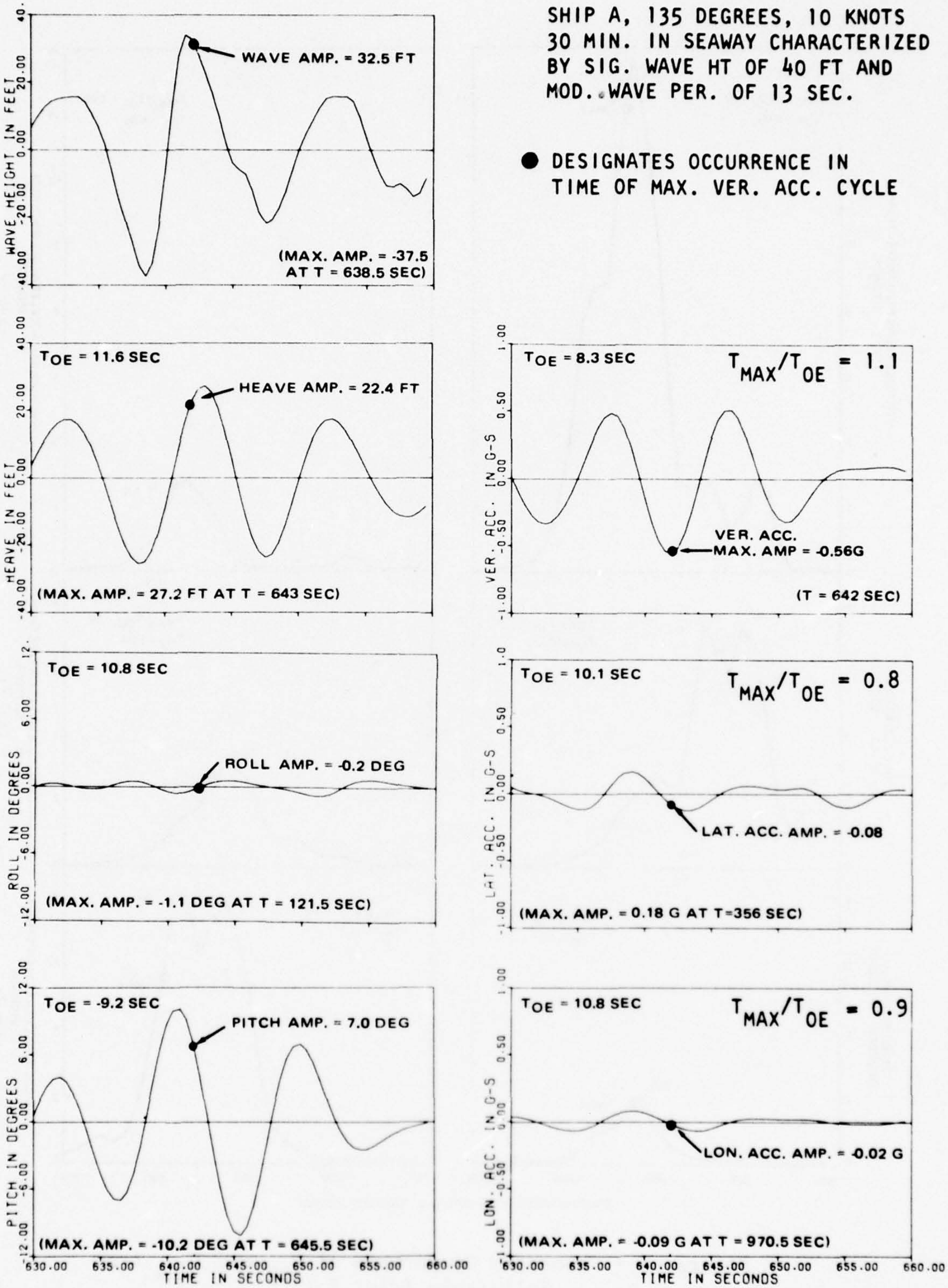


Figure 13 - Typical Predicted Short Crested Wave and Ship Response Time History Segments from Reference 2

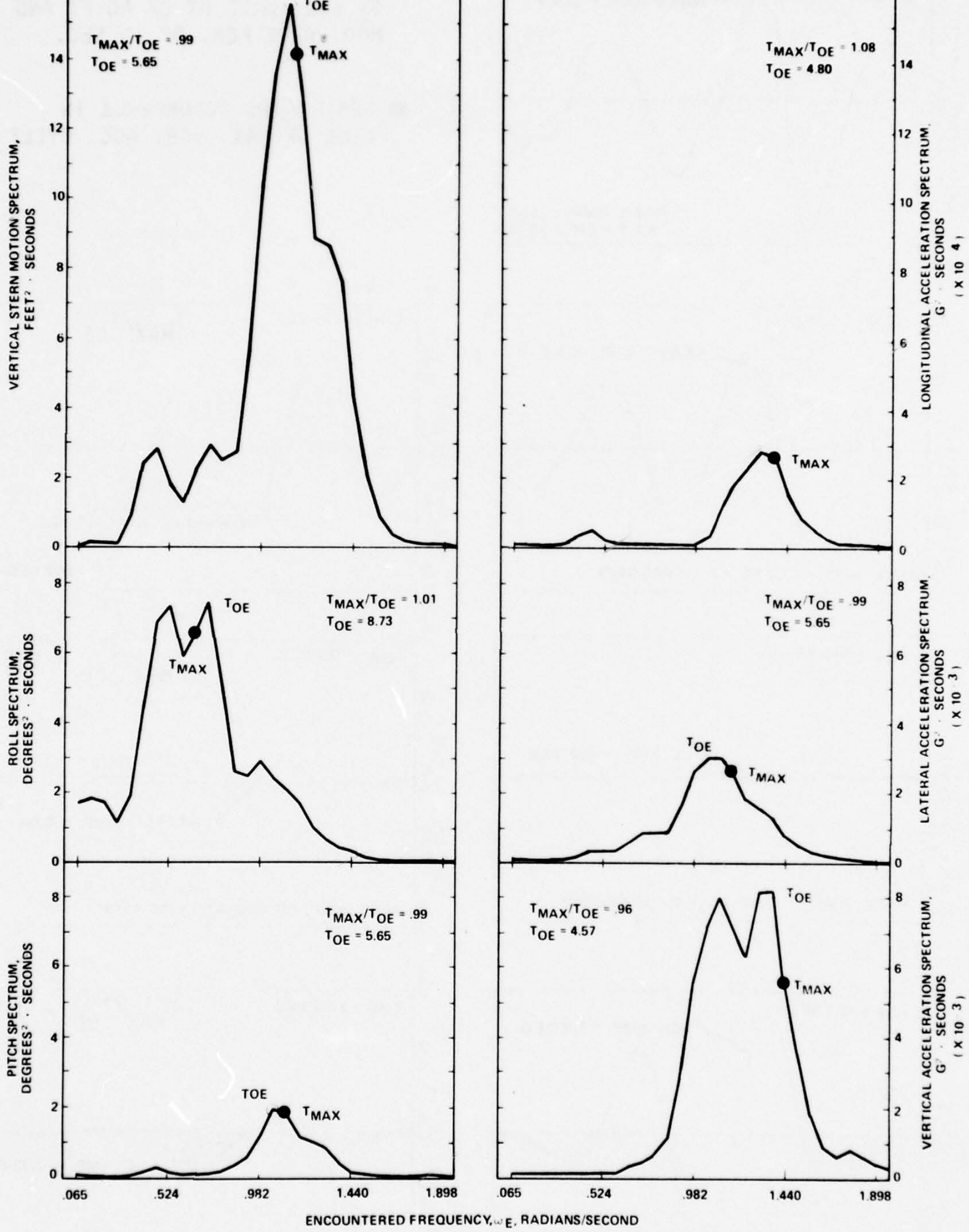


Figure 14 - Favorable Comparison of T_{OE} and T_{MAX} from Full-Scale Trial Data

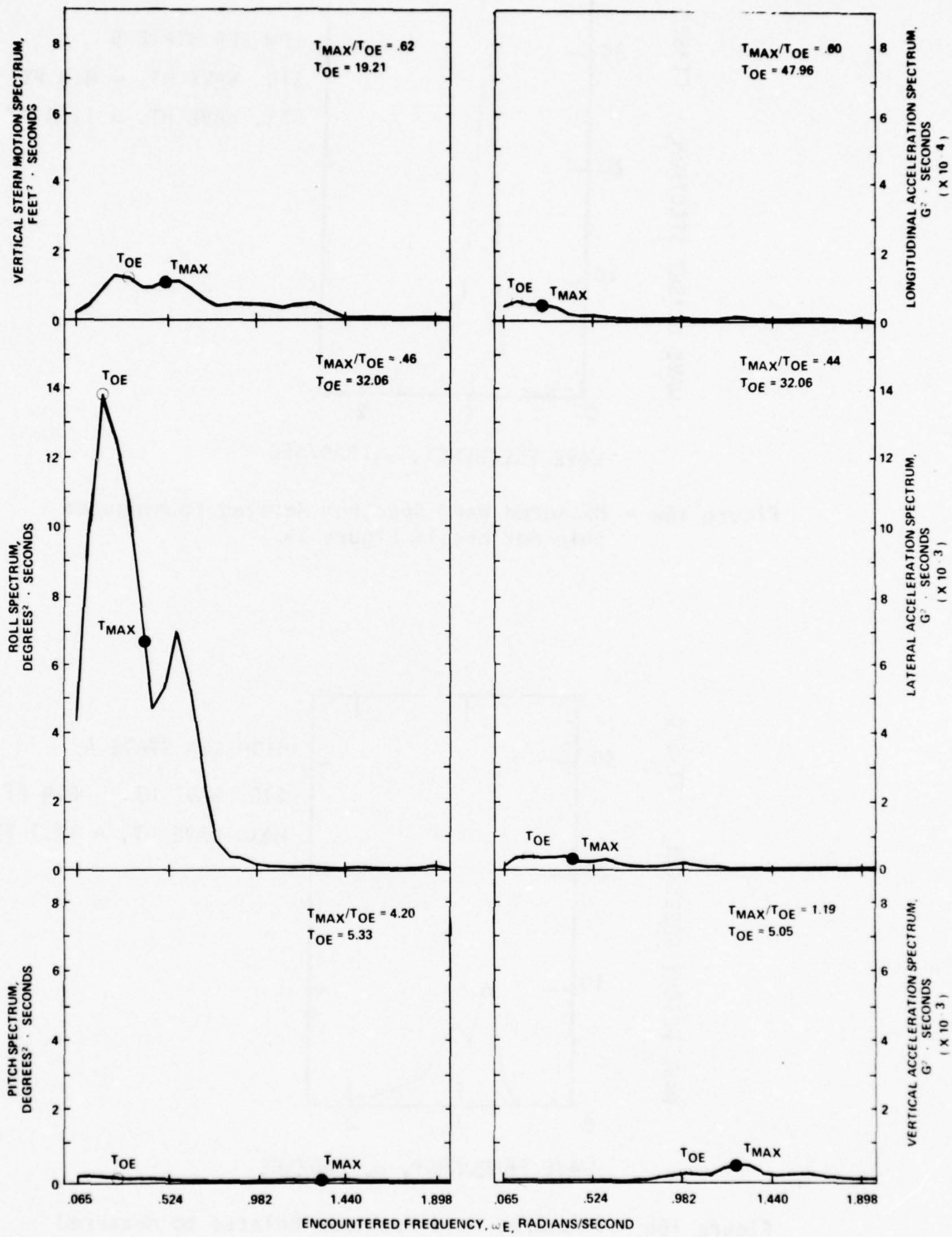


Figure 15 - Unfavorable Comparison of T_{OE} and T_{MAX} from Full-Scale Trial Data

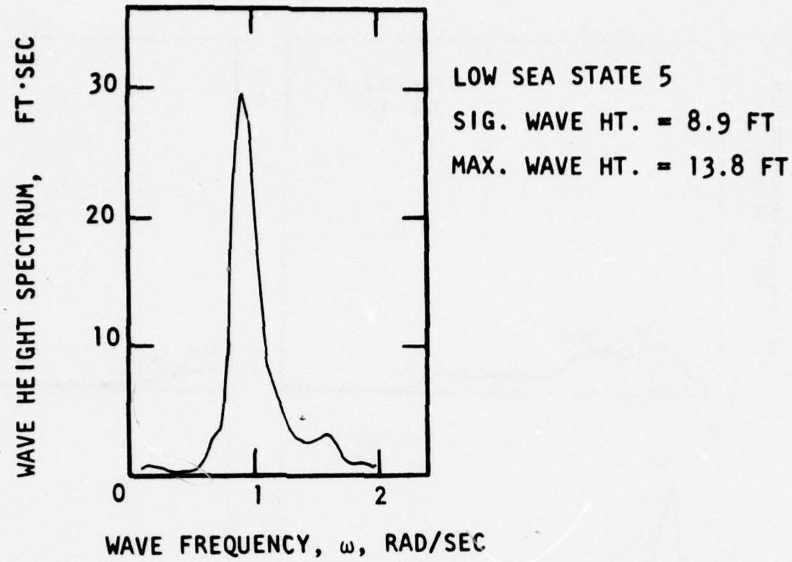


Figure 16a - Measured Wave Spectrum Related to Measured Ship Motions in Figure 14

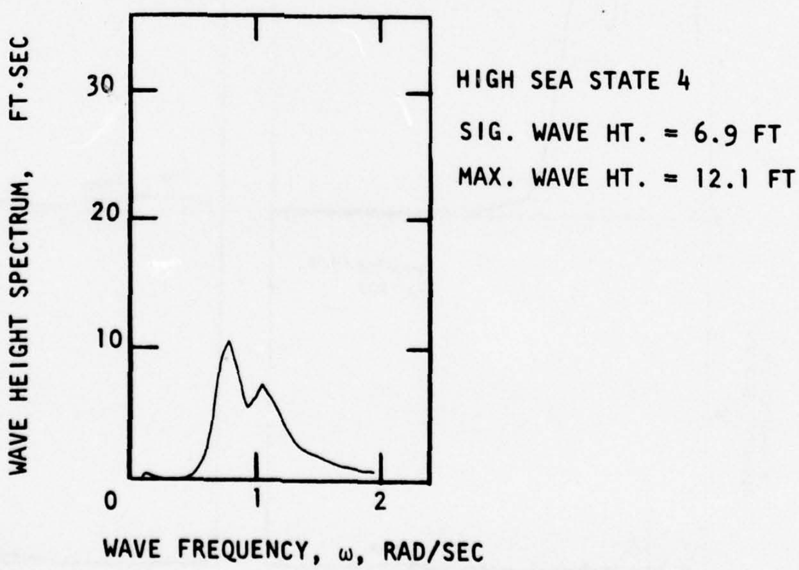


Figure 16b - Measured Wave Spectrum Related to Measured Ship Motions in Figure 15

Figure 16 - Measured North Atlantic Sea Spectra

APPENDIX D

LNG SHIP RESPONSE DATA BASE

Table 2 presents a summary of the tables and figures which comprise the LNG ship response data base presented in this appendix. RMS ship responses, i.e., heave, roll pitch, and longitudinal, lateral, and vertical accelerations at the center of the forward tank, as well as the associated periods, T_{OE}, are given. As the data are primarily intended for prediction of ship responses in extreme seas, the RMS roll values have been reduced by the appropriate factors discussed in Appendix B. The accelerations are all multiplied by 100. A ship heading angle of 0 degrees represents following seas and 180 degrees represents head seas.

The figures consist of two types. The first type presents the RMS response surfaces, Figures 17 to 21. Each of these figures contain a given speed. The surfaces are functions of ship heading and sea condition (modal wave period). No representation of the periods associated with the responses is given.

The second type presents the response density plots, Figures 22 through 30. The density plots show RMS responses versus the associated periods, T_{OE}. Each figure is for a given ship/load condition and contains response/period pairs for all headings, speeds, and sea conditions.

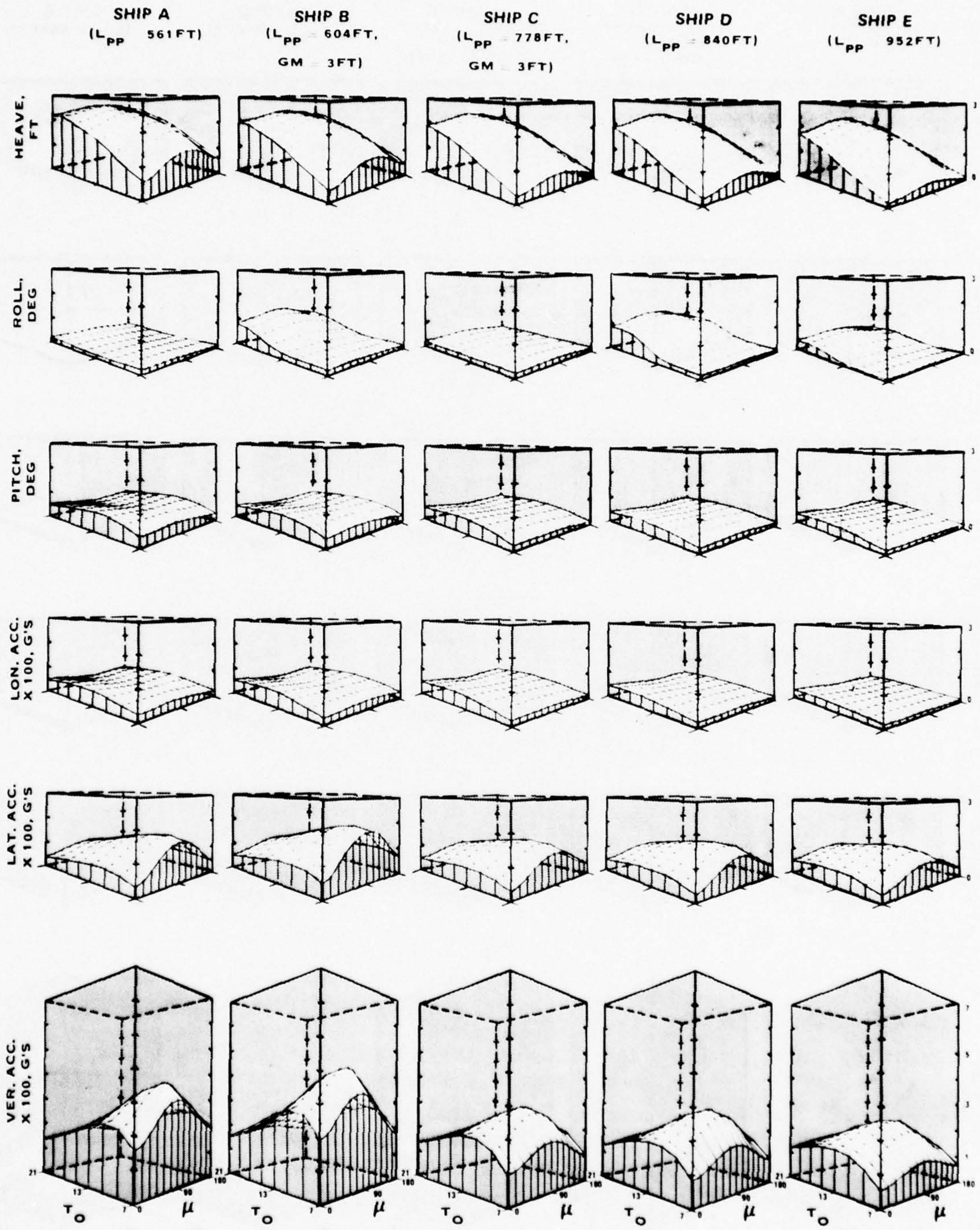
Tables 3 through 48 contain the responses and periods for ship speeds of 0, 5, . . ., 20 knots, ship sheadings of 0, 15, . . ., 180 degrees in short crested seas with modal periods 7, 9, . . ., 21 seconds and significant wave heights of one foot. Each table is for a given response type, e.g., heave. For Ships B and C, which each have three load (GM) cases, heave and pitch tables are given only once as they do not change with the variations in GM.

TABLE 2 - DESCRIPTION OF DATA BASE PRESENTATION

Ship	Figure Numbers		Response/Period Table Numbers					
	Response Surface Plots	All Response Density Plots	Heave	Roll	Pitch	Lon. Acc.	Lat. Acc.	Ver. Acc.
A	17 - 21	22	3	4	5	6	7	8
B, GM = 1.5 Ft	-	23	9	11	10	12	13	14
B, GM = 3 Ft	17 - 21	24	9	15	10	16	17	18
B, GM = 6 Ft	-	25	9	19	10	20	21	22
C, GM = 2 Ft	-	26	23	25	24	26	27	28
C, GM = 3 Ft	17 - 21	27	23	29	24	30	31	32
C, GM = 4 Ft	-	28	23	33	24	34	35	36
D	17 - 21	29	37	38	39	40	41	42
E	17 - 21	30	43	44	45	46	47	48

Note:
1. Responses are RMS values for 1 foot significant wave height and periods are encountered modal periods, T_{OE}, in seconds.
2. 0 degrees is following seas, 180 degrees is head seas.
3. All accelerations are x 100 and at center of forward tank.

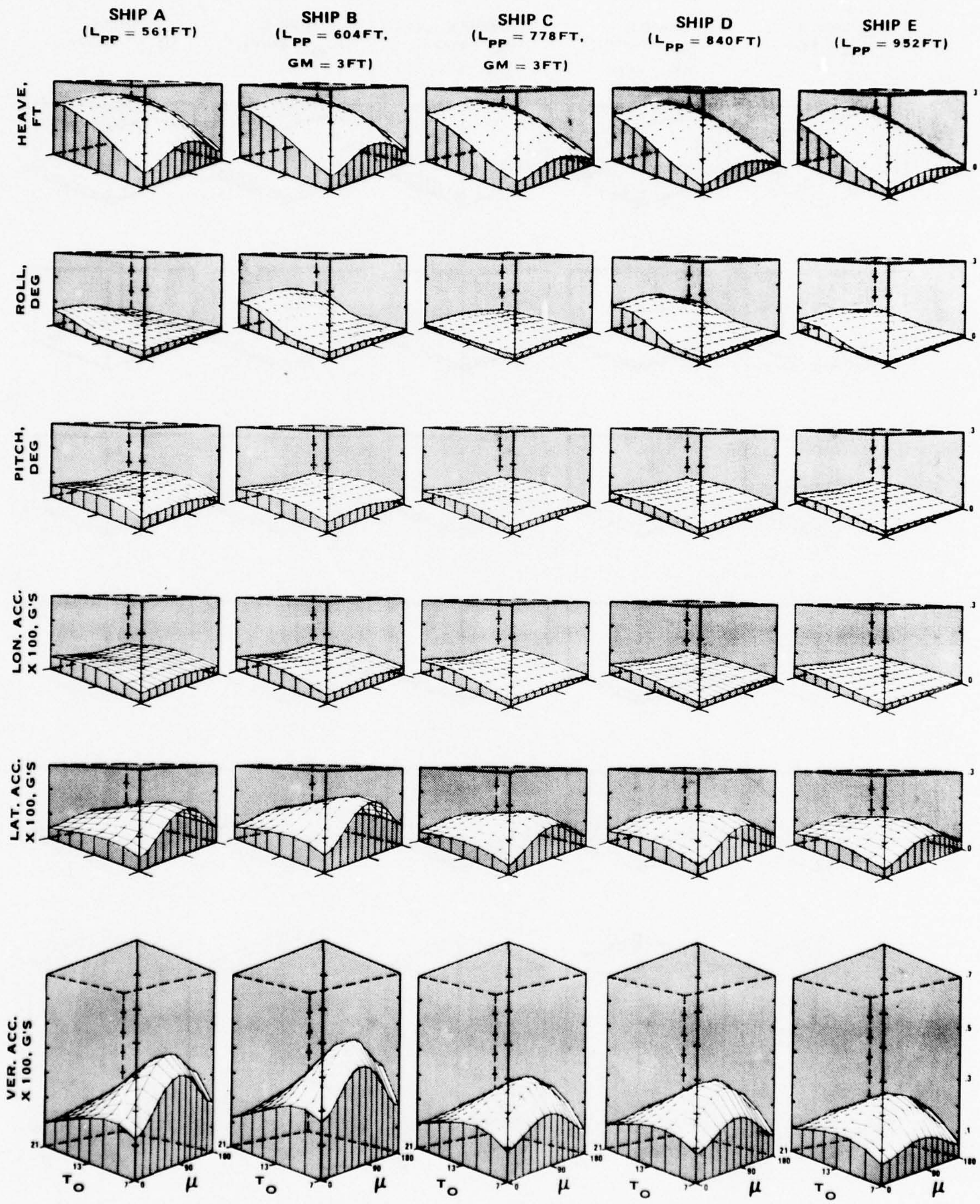
LNG SERIES
ROOT MEAN SQUARE RESPONSE SURFACES
UNIT SIGNIFICANT WAVE HEIGHT
0 KNOTS



NOTE: T_O IS MODAL WAVE PERIOD IN SECONDS.
μ IS SHIP HEADING IN DEGREES, 180 DEGREES IS HEAD SEAS.

Figure 17 - RMS Response Surfaces of LNG Series, 0 Knots

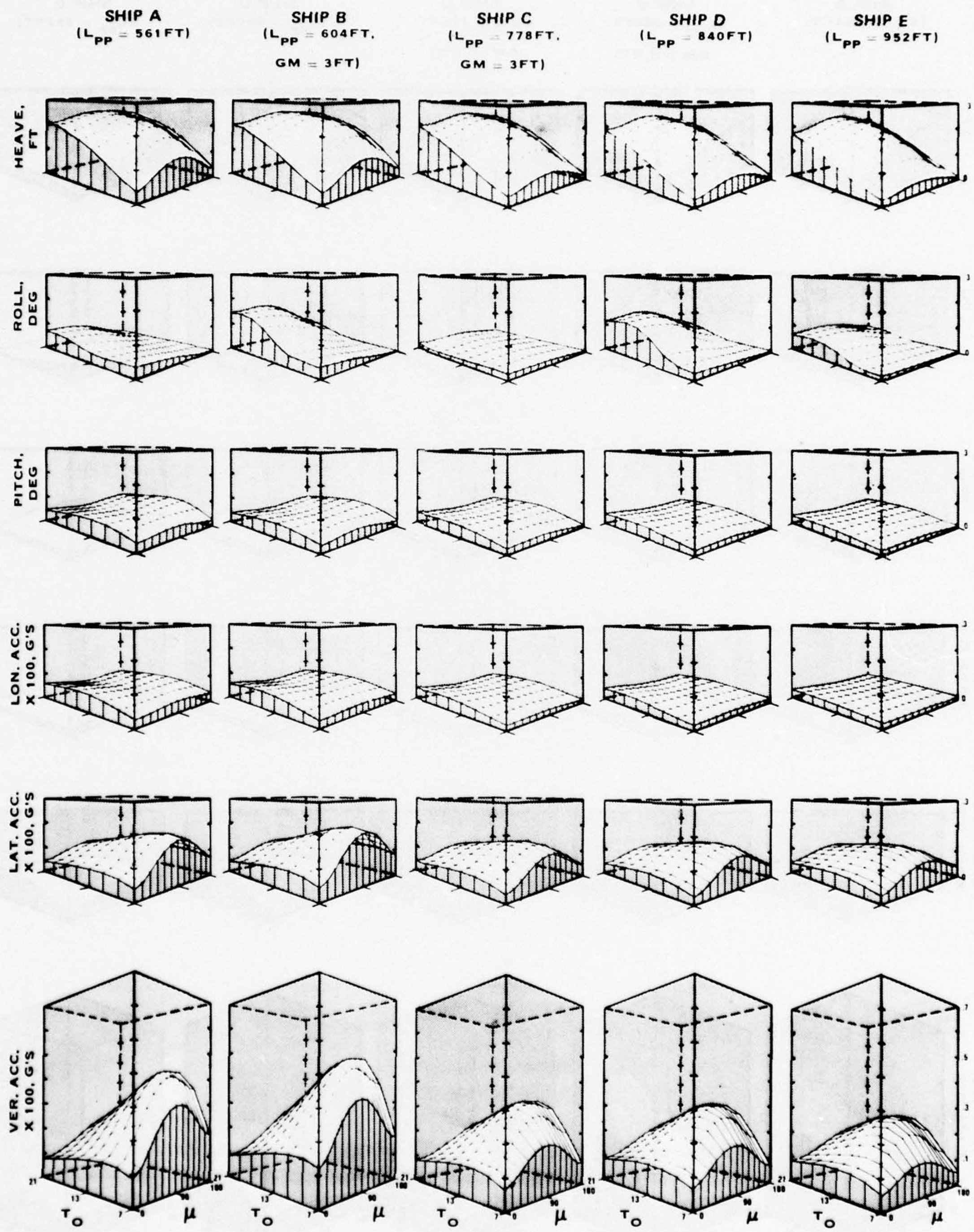
LNG SERIES
ROOT MEAN SQUARE RESPONSE SURFACES
UNIT SIGNIFICANT WAVE HEIGHT
5 KNOTS



NOTE: T_O IS MODAL WAVE PERIOD IN SECONDS.
μ IS SHIP HEADING IN DEGREES, 180 DEGREES IS HEAD SEAS.

Figure 18 - RMS Response Surfaces of LNG Series, 5 Knots

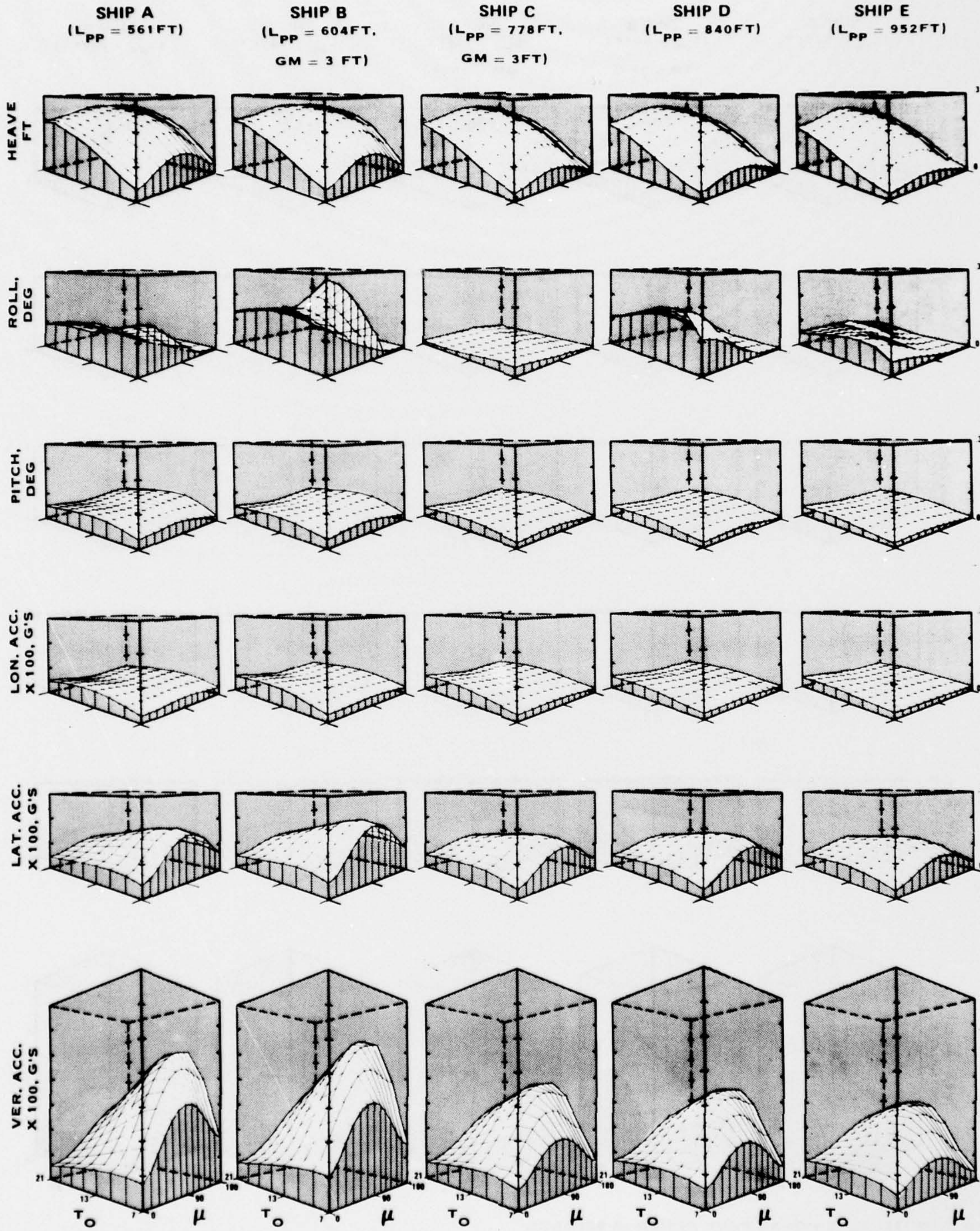
LNG SERIES
ROOT MEAN SQUARE RESPONSE SURFACES
UNIT SIGNIFICANT WAVE HEIGHT
10 KNOTS



NOTE: T_O IS MODAL WAVE PERIOD IN SECONDS.
μ IS SHIP HEADING IN DEGREES, 180 DEGREES IS HEAD SEAS.

Figure 19 - RMS Response Surfaces of LNG Series, 10 Knots

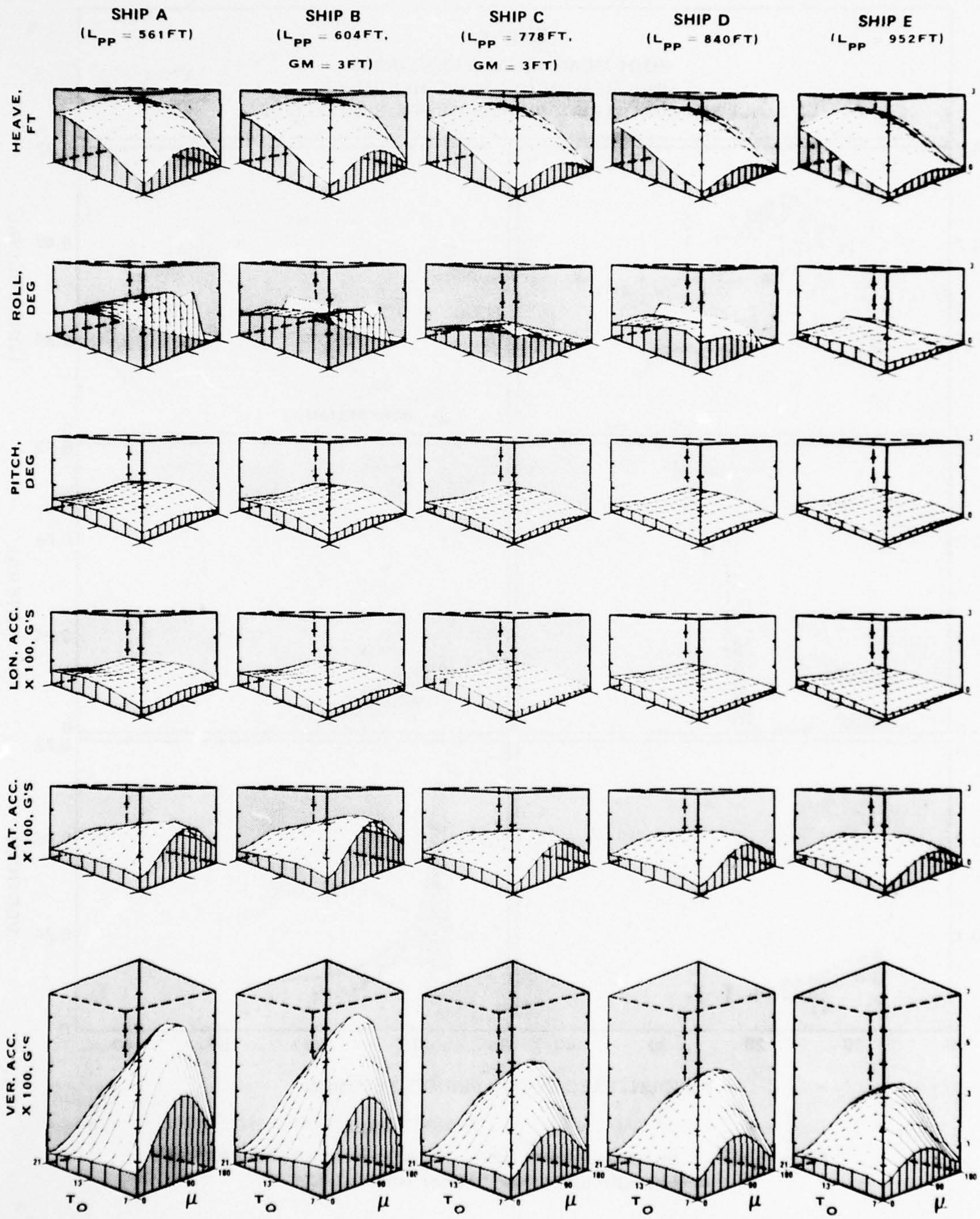
LNG SERIES
ROOT MEAN SQUARE RESPONSE SURFACES
UNIT SIGNIFICANT WAVE HEIGHT
15 KNOTS



NOTE: T_O IS MODAL WAVE PERIOD IN SECONDS.
μ IS SHIP HEADING IN DEGREES, 180 DEGREES IS HEAD SEAS.

Figure 20 - RMS Response Surfaces of LNG Series, 15 Knots

LNG SERIES
ROOT MEAN SQUARE RESPONSE SURFACES
UNIT SIGNIFICANT WAVE HEIGHT
20 KNOTS



NOTE: T_O IS MODAL WAVE PERIOD IN SECONDS.

μ IS SHIP HEADING IN DEGREES, 180 DEGREES IS HEAD SEAS.

Figure 21 - RMS Response Surfaces of LNG Series, 20 Knots

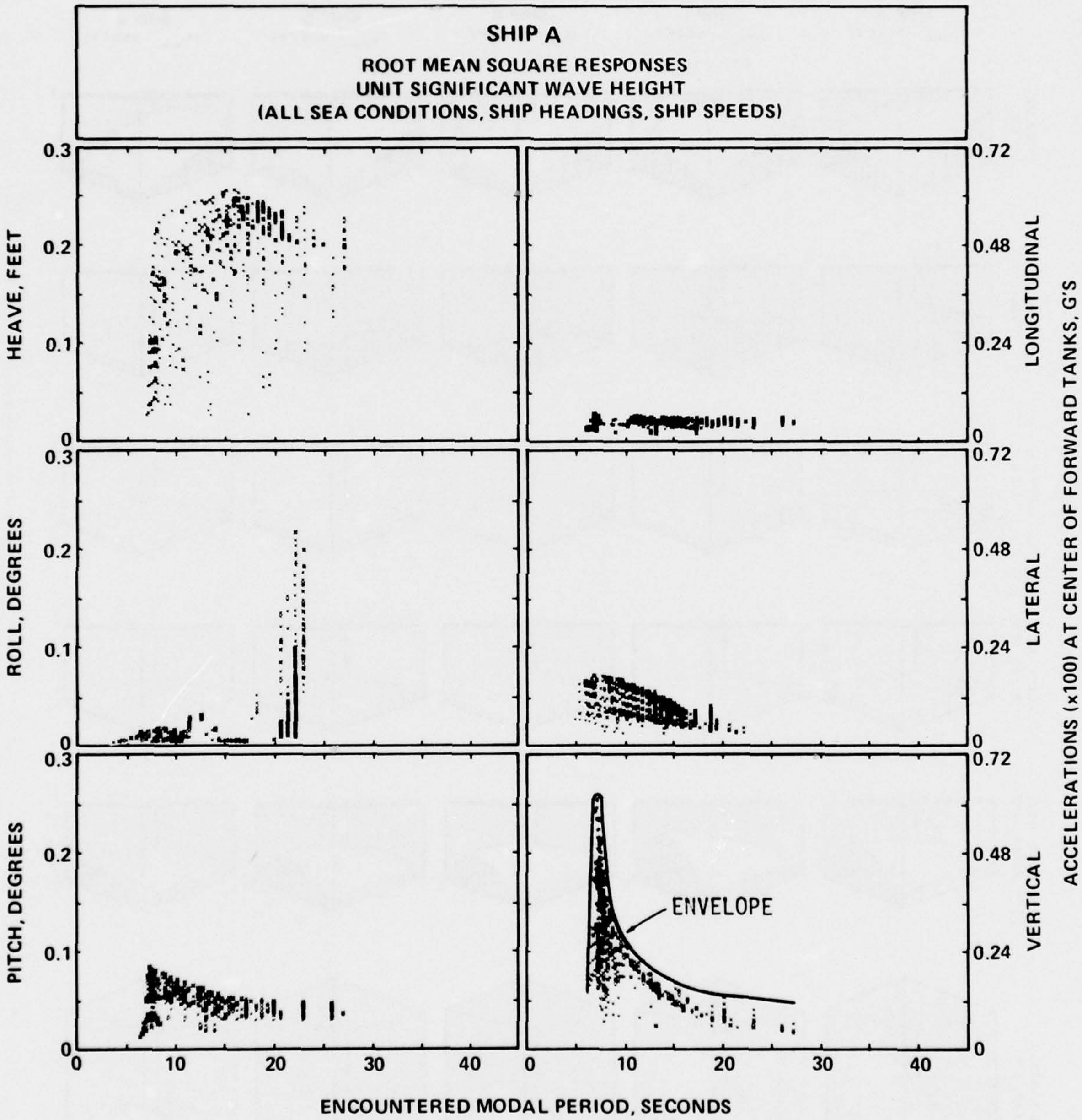


Figure 22 - Ship A, Root Mean Square Responses versus Encountered Modal Periods

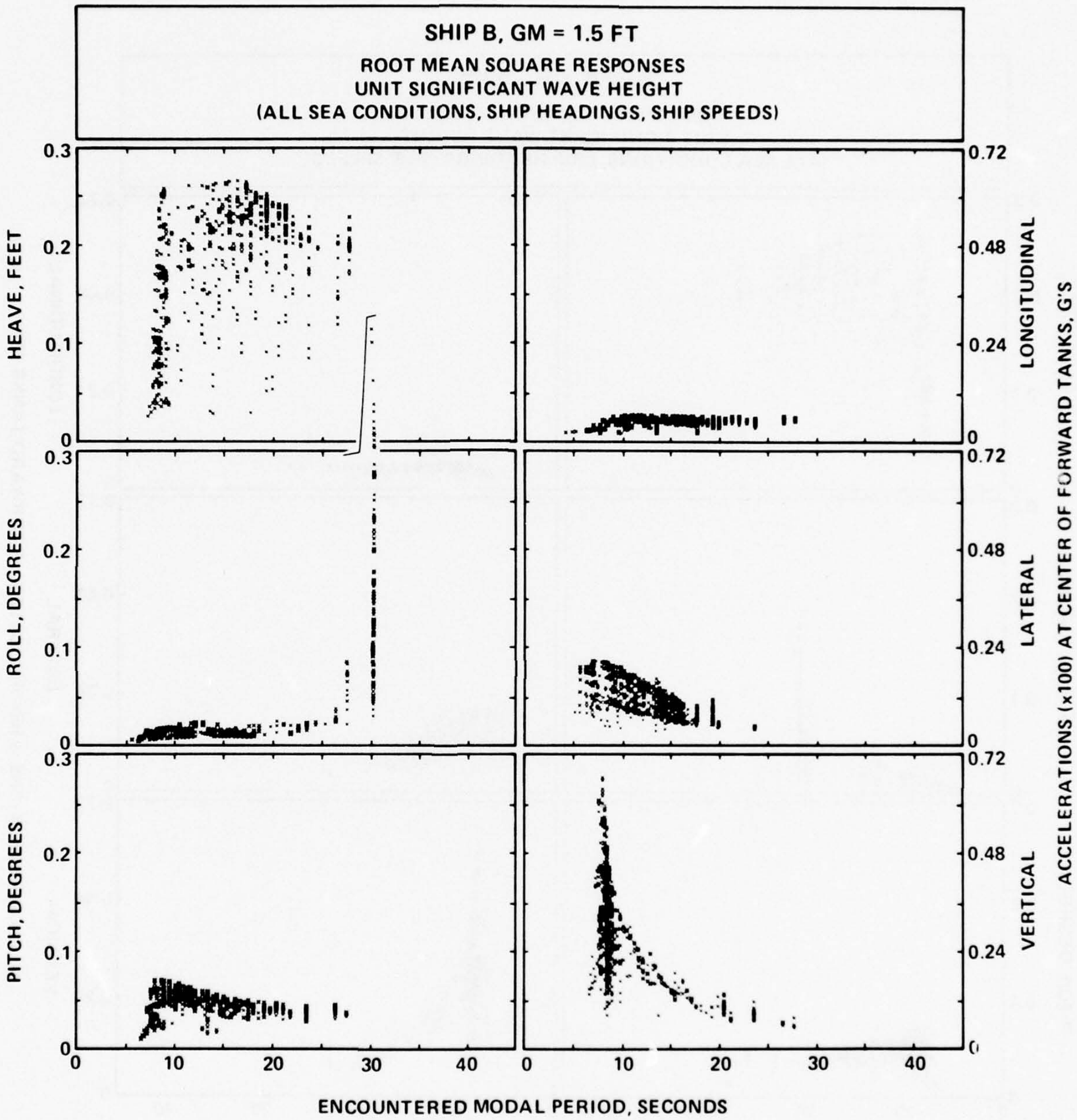


Figure 23 - Ship B, GM = 1.5 Ft, Root Mean Square Responses versus Encountered Modal Periods

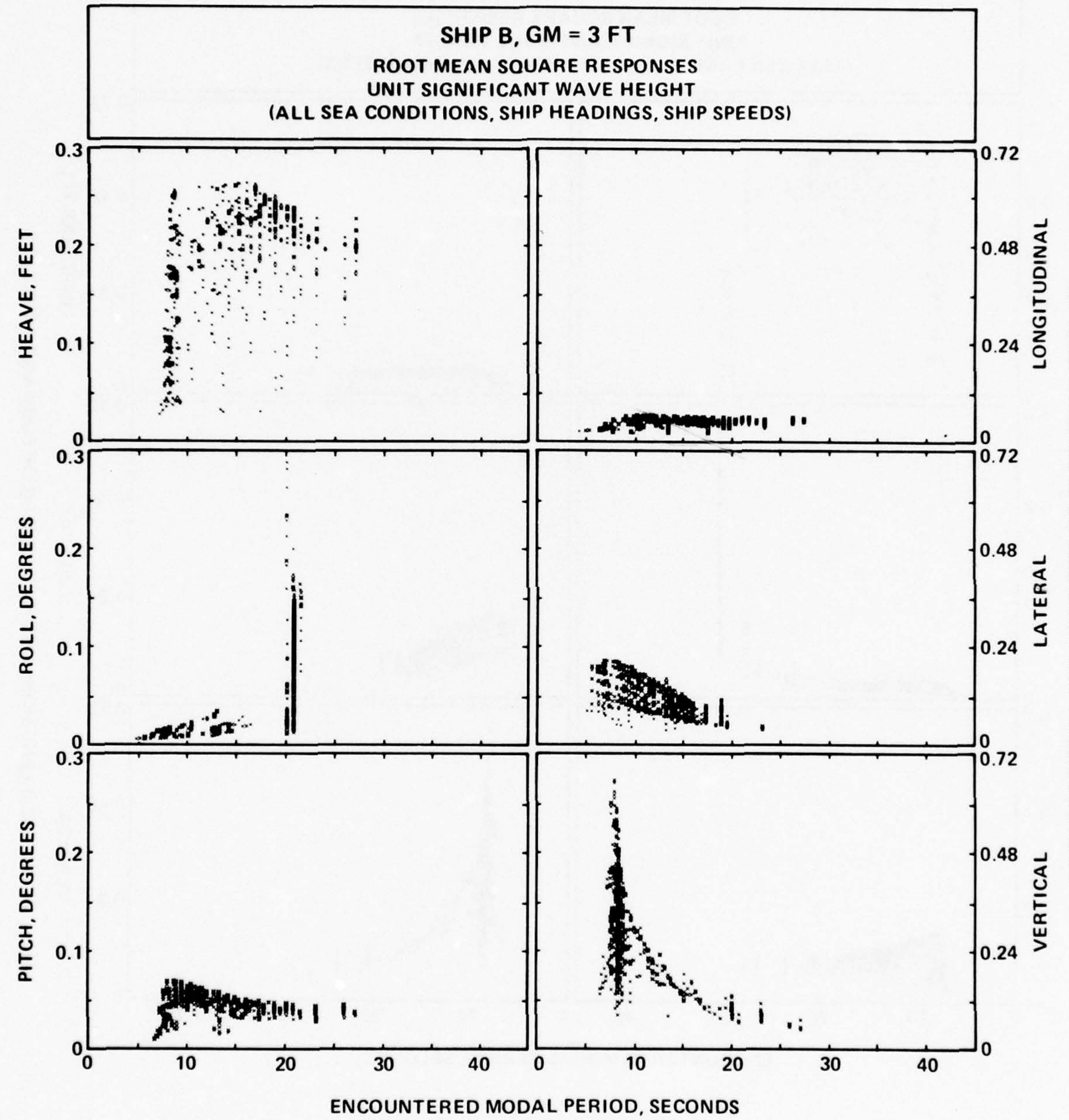


Figure 24 - Ship B, GM = 3 Ft, Root Mean Square Responses versus Encountered Modal Periods

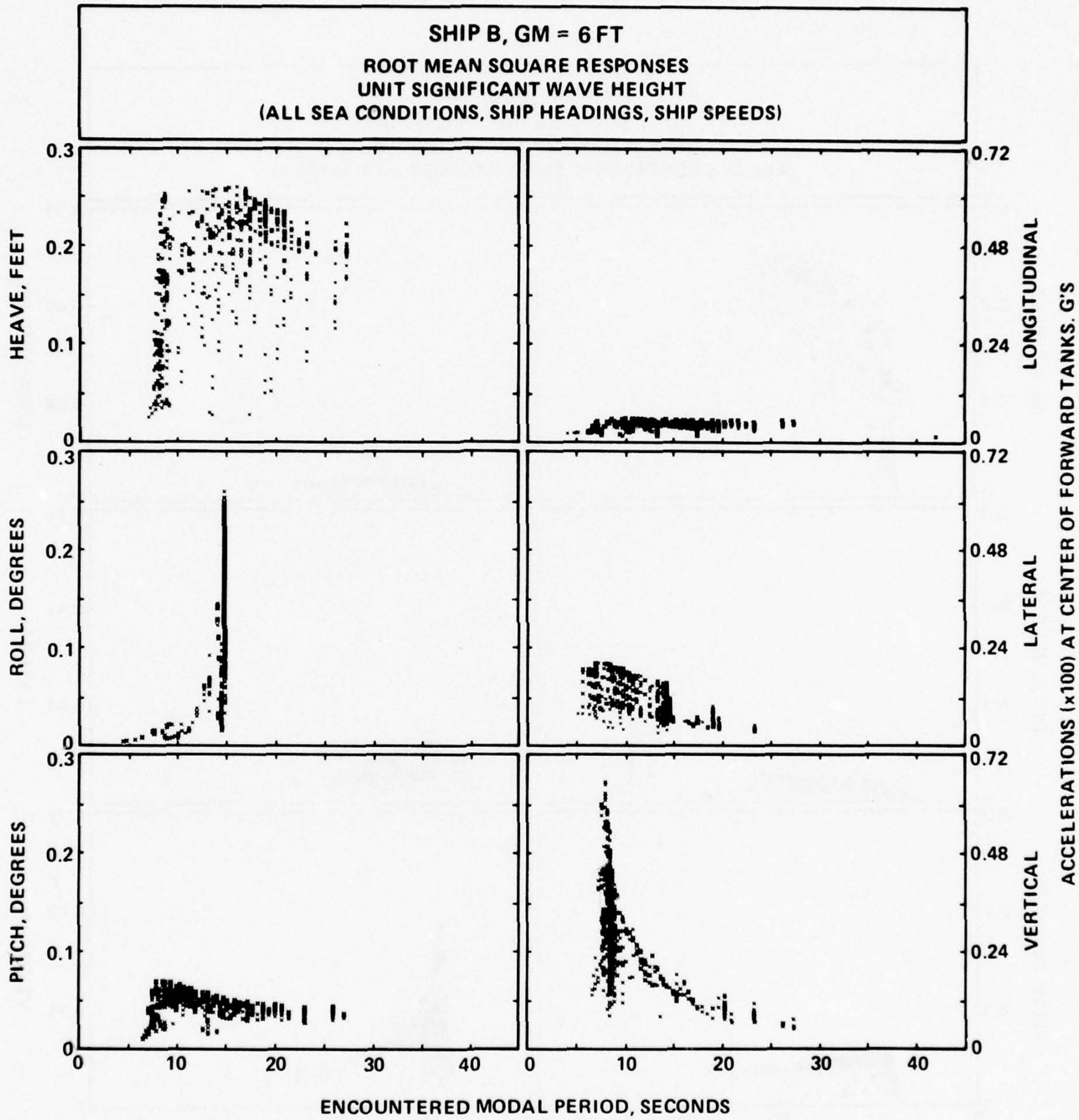


Figure 25 - Ship B, GM = 6 Ft, Root Mean Square Responses versus Encountered Modal Periods

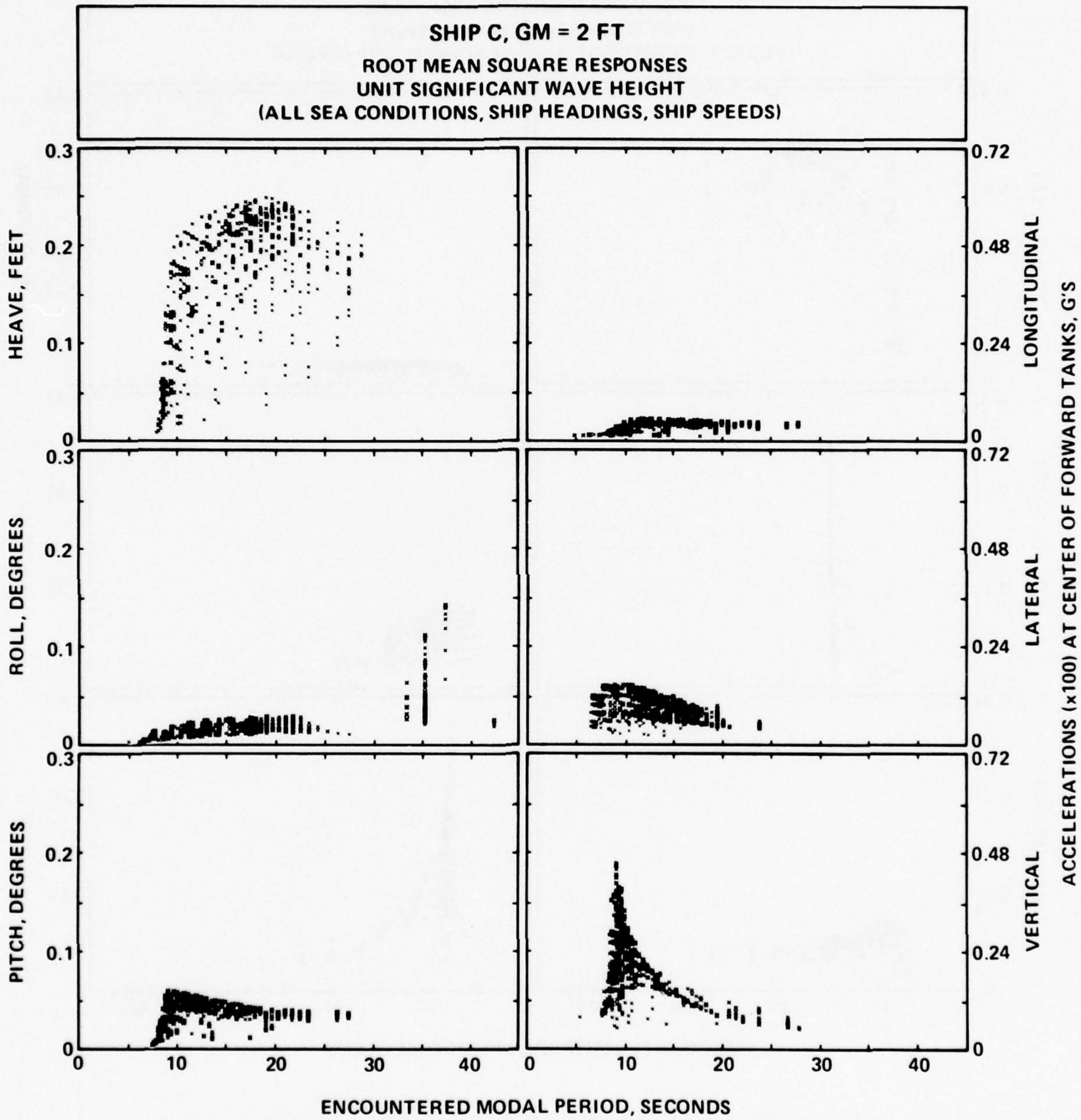


Figure 26 - Ship C, GM = 2 Ft, Root Mean Square Responses versus Encountered Modal Periods

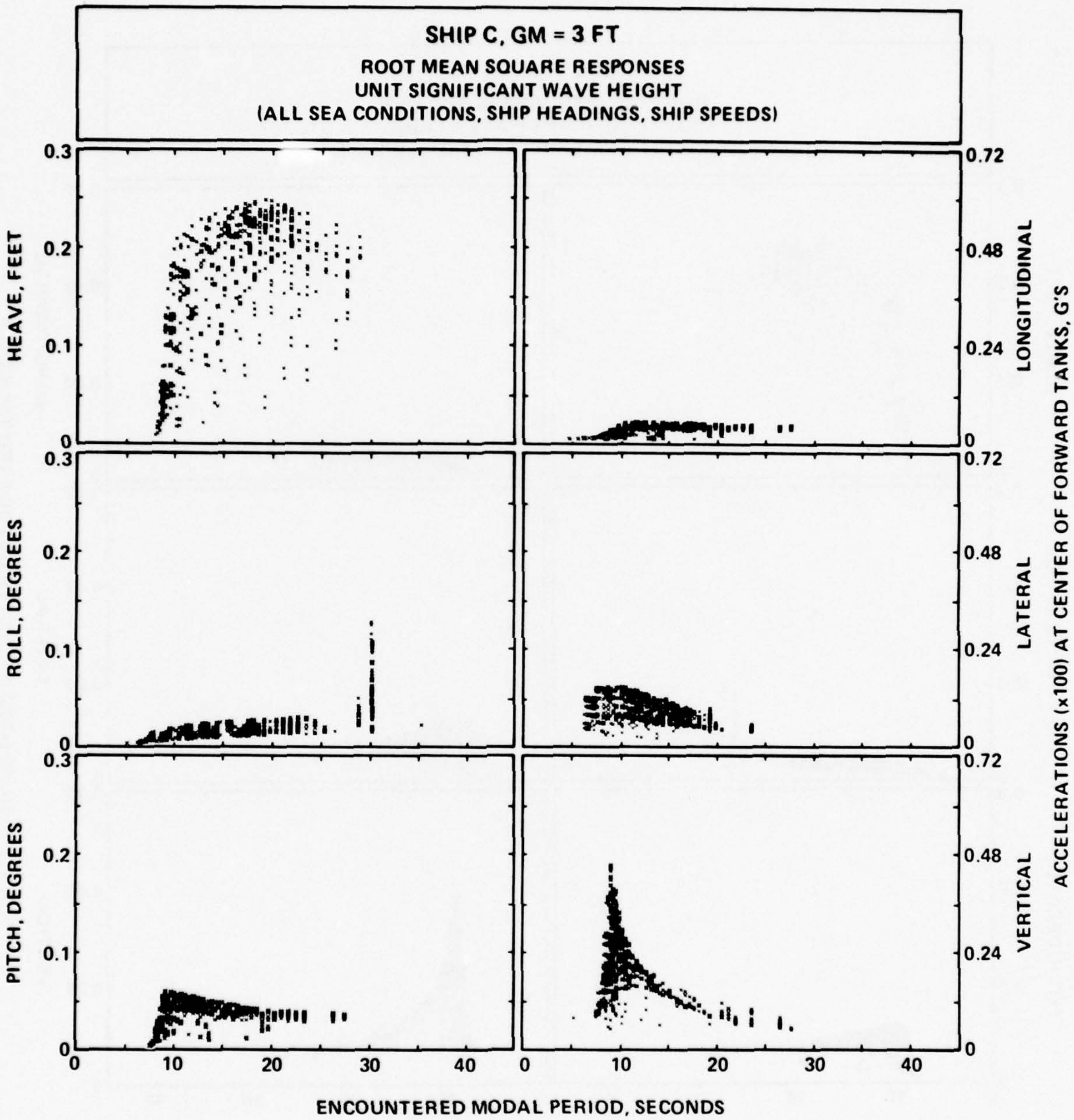


Figure 27 - Ship C, GM = 3 Ft, Root Mean Square Responses versus Encountered Modal Periods

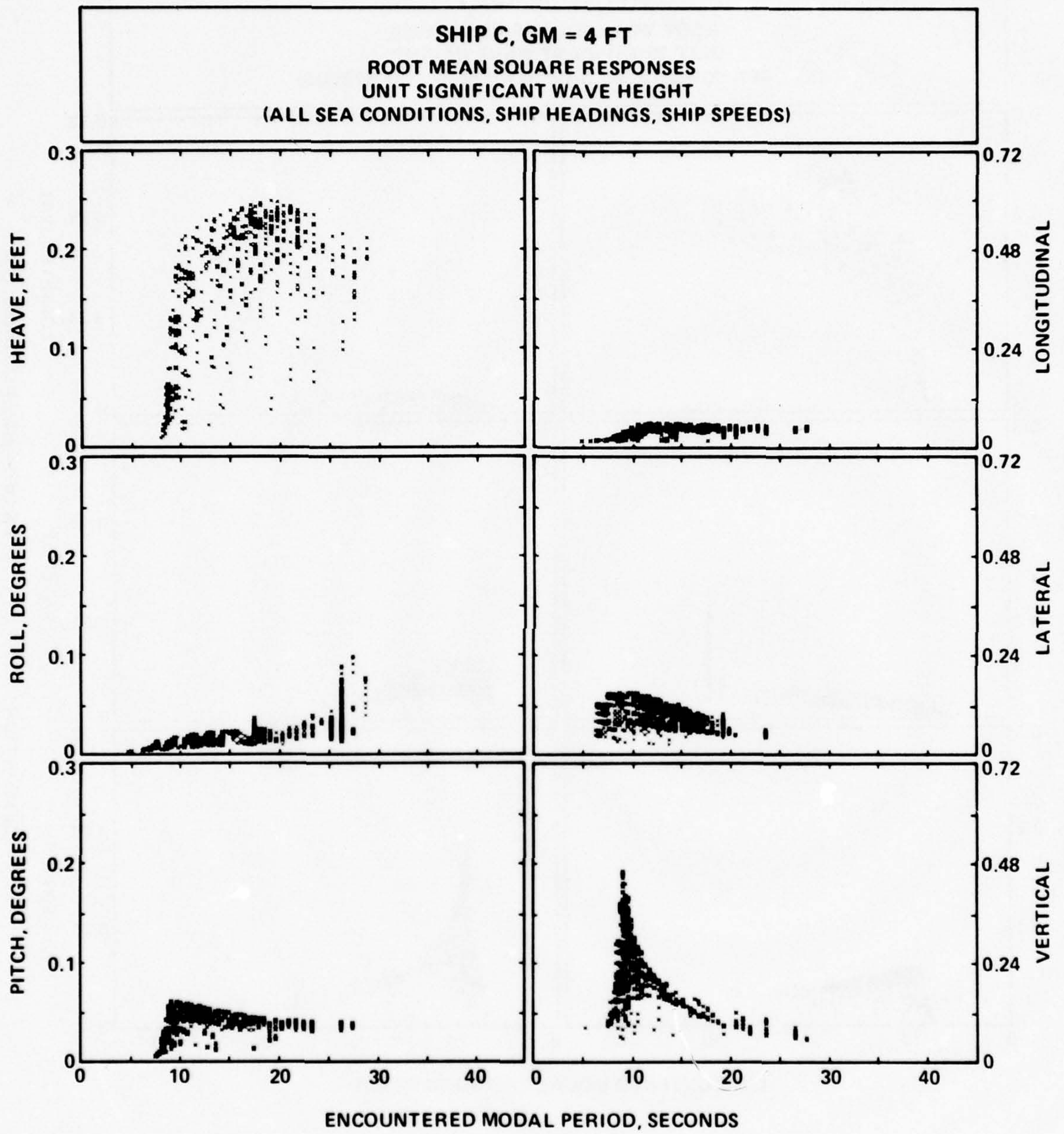


Figure 28 - Ship C, GM = 4 Ft, Root Mean Square Responses versus Encountered Modal Periods

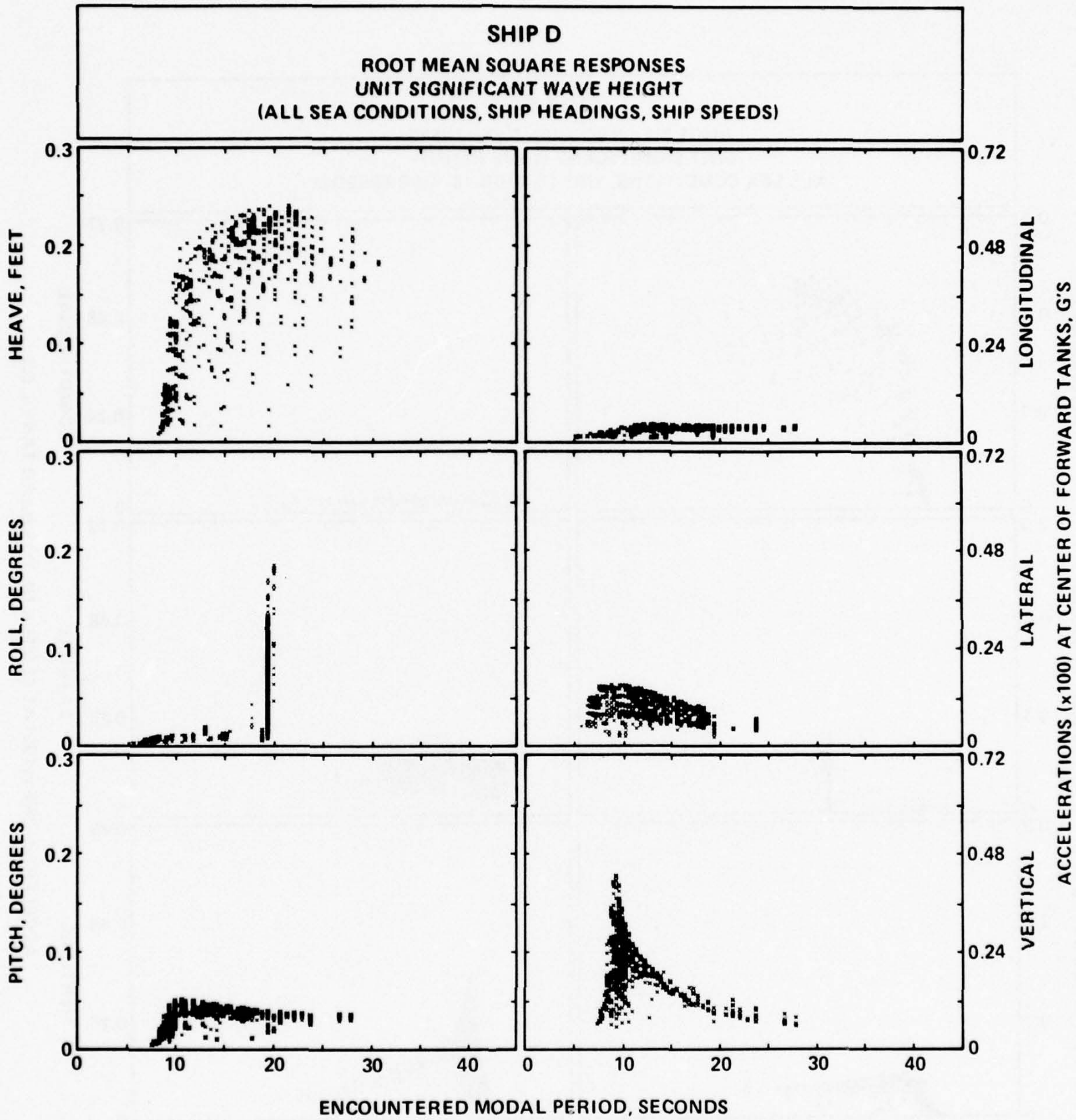


Figure 29 - Ship D, Root Mean Square Responses versus Encountered Modal Periods

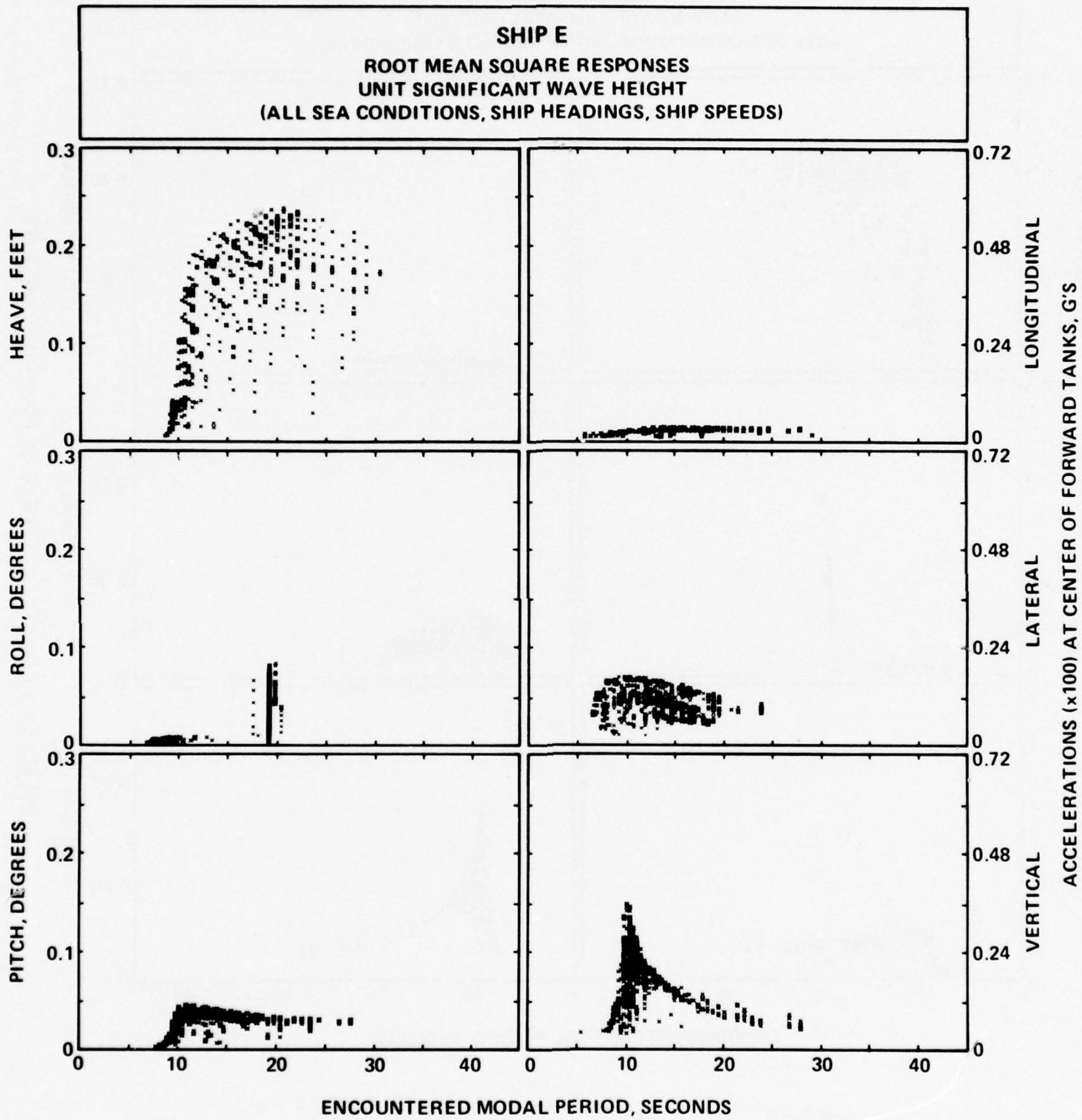


Figure 30 - Ship E, Root Mean Square Responses versus Encountered Modal Periods

TABLE 3 - SHIP A, ROOT MEAN SQUARE HEAVE RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP A (SPHERICAL TANKS)

RMS HEAVE IN FEET/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.044/ 8.1	.050/ 8.1	.065/ 8.1	.082/ 8.1	.095/ 8.1	.104/ 8.1	.107/ 8.1	.104/ 8.1	.095/ 8.1	.082/ 8.1	.065/ 8.1	.050/ 8.1	.044/ 8.1
	9	.074/10.8	.084/10.8	.105/ 8.7	.129/ 9.0	.149/ 9.0	.162/ 9.0	.167/ 9.0	.162/ 9.0	.149/ 9.0	.129/ 9.0	.106/ 8.7	.084/10.8	.075/10.8
	11	.110/12.6	.118/12.6	.137/12.1	.160/12.1	.179/11.6	.193/11.2	.197/11.2	.193/11.2	.180/11.6	.160/12.1	.138/12.1	.119/12.6	.112/12.6
	13	.145/14.3	.150/14.3	.165/14.0	.183/13.7	.199/13.4	.211/13.4	.215/13.4	.211/13.4	.200/13.4	.184/13.7	.166/14.0	.152/14.3	.146/14.3
	15	.171/16.1	.175/16.1	.186/15.7	.200/15.3	.213/15.3	.222/15.3	.225/15.3	.222/15.3	.214/15.3	.201/15.3	.188/15.7	.177/15.7	.173/16.1
	17	.191/17.5	.194/17.5	.201/17.5	.212/17.5	.222/17.5	.229/17.0	.232/17.0	.230/17.0	.223/17.5	.213/17.5	.203/17.5	.195/17.5	.192/17.5
	19	.211/19.6	.213/19.6	.219/19.6	.227/19.0	.234/19.0	.240/19.0	.242/19.0	.240/19.0	.235/19.0	.228/19.0	.220/19.0	.214/19.0	.212/19.0
	21	.210/20.9	.212/20.9	.217/20.9	.223/20.9	.229/20.9	.234/20.9	.236/20.9	.234/20.9	.230/20.9	.224/20.9	.218/20.9	.213/20.9	.212/20.9
5	7	.038/ 9.5	.046/ 9.2	.063/ 8.1	.080/ 8.1	.094/ 8.1	.103/ 8.1	.106/ 8.1	.103/ 8.1	.094/ 8.1	.079/ 8.1	.062/ 7.9	.045/ 7.9	.038/ 7.5
	9	.067/12.6	.077/10.1	.100/ 9.8	.125/ 9.5	.146/ 9.2	.161/ 9.0	.167/ 9.0	.164/ 9.0	.152/ 9.0	.133/ 9.0	.109/ 9.2	.088/ 9.5	.079/ 9.5
	11	.103/14.3	.111/14.0	.131/13.7	.155/13.1	.176/12.1	.191/11.6	.198/11.2	.196/10.8	.185/10.8	.167/10.8	.146/10.8	.127/11.2	.120/11.2
	13	.138/15.7	.144/15.7	.159/15.3	.178/15.0	.196/14.3	.209/13.7	.216/13.4	.214/13.1	.205/12.8	.191/12.8	.174/12.8	.160/12.8	.155/12.8
	15	.165/17.5	.170/17.5	.181/17.0	.195/16.5	.210/16.1	.221/15.7	.226/15.3	.225/15.0	.218/14.6	.207/14.6	.195/14.6	.185/14.6	.181/14.6
	17	.186/19.0	.189/19.0	.197/19.0	.208/18.5	.219/18.0	.228/17.5	.232/17.0	.232/17.0	.227/16.5	.219/16.5	.209/16.1	.202/16.1	.199/16.1
	19	.206/20.9	.208/20.9	.215/20.9	.223/20.3	.232/20.3	.239/19.6	.242/19.0	.242/19.0	.239/18.5	.232/18.5	.226/18.0	.220/18.0	.218/18.0
	21	.206/21.7	.208/21.7	.213/20.9	.220/20.9	.227/20.3	.233/20.3	.236/19.6	.236/19.6	.233/19.6	.228/19.6	.223/19.6	.219/19.6	.217/19.6
10	7	.032/13.4	.041/ 8.3	.060/ 8.3	.078/ 8.1	.093/ 8.1	.102/ 8.1	.105/ 8.1	.102/ 8.1	.092/ 7.9	.078/ 7.9	.059/ 7.7	.041/ 7.7	.033/ 7.7
	9	.061/13.4	.072/13.4	.096/10.5	.122/ 9.2	.144/ 9.0	.160/ 8.7	.168/ 8.7	.166/ 8.5	.156/ 8.5	.138/ 8.5	.115/ 8.5	.095/ 8.5	.086/ 8.5
	11	.099/16.5	.107/16.5	.127/16.1	.152/13.4	.174/12.1	.192/11.2	.201/10.8	.201/10.1	.192/10.1	.177/ 9.8	.158/ 9.8	.142/ 9.8	.135/ 9.8
	13	.134/18.0	.139/18.0	.155/17.5	.175/17.0	.194/15.7	.209/14.0	.218/13.4	.219/12.8	.213/12.1	.201/11.6	.187/11.6	.175/11.6	.170/11.6
	15	.161/19.0	.165/19.0	.177/19.0	.192/18.5	.208/17.5	.220/16.5	.228/15.3	.229/14.6	.225/14.0	.216/14.0	.206/13.7	.197/13.4	.194/13.4
	17	.182/20.9	.185/20.9	.193/20.3	.205/20.3	.217/19.0	.227/18.5	.234/17.5	.235/16.5	.232/16.1	.226/15.7	.218/15.3	.212/15.0	.210/15.0
	19	.203/22.4	.205/21.7	.211/21.7	.221/20.9	.230/20.3	.238/19.0	.244/18.5	.245/18.5	.243/18.0	.239/17.5	.233/17.0	.229/17.0	.227/17.0
	21	.203/22.4	.205/22.4	.210/21.7	.218/20.9	.226/20.3	.233/19.6	.237/19.0	.239/18.5	.237/18.5	.234/18.5	.229/18.5	.226/18.5	.224/18.5
15	7	.029/17.5	.039/ 9.0	.058/ 8.7	.077/ 8.3	.091/ 8.1	.101/ 8.1	.104/ 7.7	.101/ 7.7	.091/ 7.7	.076/ 7.5	.058/ 7.5	.039/ 7.5	.030/ 7.3
	9	.058/19.6	.069/19.6	.093/10.1	.120/ 9.2	.143/ 9.0	.160/ 8.5	.169/ 8.3	.169/ 8.3	.160/ 8.1	.143/ 8.1	.122/ 7.9	.103/ 7.9	.095/ 7.9
	11	.096/20.3	.104/20.3	.124/20.3	.149/20.3	.173/12.6	.193/10.1	.204/ 9.8	.207/ 9.2	.202/ 9.0	.190/ 8.7	.174/ 8.5	.160/ 8.5	.155/ 8.5
	13	.130/20.9	.136/20.9	.152/20.9	.172/20.3	.193/15.7	.210/13.7	.222/13.1	.226/12.1	.224/11.2	.215/10.8	.205/10.5	.195/10.1	.191/10.1
	15	.158/21.7	.162/21.7	.174/21.7	.190/20.9	.206/20.3	.221/16.5	.231/15.3	.236/14.3	.235/13.7	.229/13.1	.222/12.6	.215/12.6	.212/12.1
	17	.179/23.3	.182/23.3	.190/22.4	.203/22.4	.216/20.9	.228/19.0	.236/17.5	.241/16.5	.240/15.3	.237/14.6	.231/14.6	.227/14.3	.225/14.0
	19	.200/24.2	.202/24.2	.209/24.2	.218/22.4	.229/22.4	.239/19.0	.246/19.0	.249/17.5	.250/17.0	.247/16.5	.243/16.1	.240/16.1	.239/15.7
	21	.201/25.1	.203/25.1	.208/24.2	.216/24.2	.225/22.4	.233/20.9	.239/19.0	.242/17.5	.242/17.5	.241/17.0	.238/17.0	.235/17.0	.234/17.0
20	7	.028/13.7	.038/13.7	.058/ 9.5	.077/ 7.5	.092/ 7.5	.101/ 7.5	.104/ 7.5	.101/ 7.5	.091/ 7.5	.076/ 7.5	.057/ 7.3	.038/ 7.3	.028/ 7.1
	9	.056/19.0	.067/19.0	.091/19.0	.118/10.1	.143/ 8.1	.161/ 8.1	.170/ 7.9	.171/ 7.9	.163/ 7.7	.147/ 7.7	.127/ 7.5	.109/ 7.5	.101/ 7.5
	11	.093/23.3	.101/23.3	.122/23.3	.148/23.3	.173/11.2	.194/10.5	.208/ 8.7	.214/ 8.3	.212/ 8.1	.202/ 8.1	.190/ 7.9	.178/ 7.9	.173/ 7.9
	13	.128/26.2	.134/26.2	.149/23.3	.170/23.3	.193/23.3	.212/15.0	.227/12.1	.235/10.8	.236/ 9.8	.232/ 9.0	.224/ 8.5	.218/ 8.3	.215/ 8.3
	15	.155/26.2	.159/26.2	.171/26.2	.188/26.2	.206/23.3	.223/16.1	.235/15.3	.243/14.0	.246/12.8	.244/12.1	.240/11.2	.236/10.8	.234/10.8
	17	.176/27.3	.179/27.3	.188/27.3	.201/27.3	.215/23.3	.229/19.6	.240/16.5	.247/16.1	.250/15.0	.249/14.0	.247/13.7	.244/13.4	.243/13.1
	19	.198/27.3	.200/27.3	.207/27.3	.217/27.3	.228/27.3	.239/23.3	.248/17.5	.254/16.5	.257/16.1	.257/16.1	.256/15.3	.254/15.0	.254/15.0
	21	.199/27.3	.201/27.3	.206/27.3	.214/27.3	.224/27.3	.233/23.3	.241/18.5	.246/16.5	.249/16.5	.249/16.1	.248/16.1	.247/16.1	.246/16.1

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 4 - SHIP A, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP A (SPHERICAL TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.011/ 7.0	.012/ 6.8	.012/ 6.7	.013/ 6.7	.014/ 6.7	.014/ 6.7	.014/ 6.7	.014/ 6.7	.013/ 6.7	.012/ 6.7	.011/ 6.7	.011/ 6.7	.011/ 6.7
	9	.012/ 7.5	.012/ 7.5	.013/ 7.5	.014/ 7.5	.014/ 7.5	.015/ 7.5	.015/ 8.5	.014/ 8.7	.013/ 7.5	.013/ 7.5	.012/ 7.3	.011/ 7.3	.011/ 7.3
	11	.010/ 7.5	.011/ 7.5	.011/ 7.5	.012/ 9.8	.013/ 9.8	.014/ 9.8	.014/ 9.8	.013/ 9.8	.013/10.1	.012/10.1	.011/10.1	.010/ 7.5	.010/ 7.5
	13	.009/ 7.5	.009/11.2	.010/11.2	.011/10.8	.012/10.8	.012/10.8	.012/10.8	.012/10.8	.011/10.8	.010/10.8	.009/11.2	.009/11.2	.009/11.6
	15	.010/20.9	.010/20.9	.011/20.9	.011/20.9	.012/20.9	.012/20.9	.012/20.9	.012/20.9	.012/20.9	.011/20.9	.010/20.9	.010/20.9	.009/20.9
	17	.014/20.9	.014/20.9	.015/20.9	.016/20.9	.016/20.9	.017/20.9	.017/20.9	.017/20.9	.017/20.9	.016/20.9	.015/20.9	.014/20.9	.014/20.9
	19	.017/20.9	.018/20.9	.018/20.9	.020/20.9	.021/20.9	.022/20.9	.022/20.9	.022/20.9	.022/20.9	.021/20.9	.019/20.9	.018/20.9	.018/20.9
	21	.019/20.9	.019/20.9	.020/20.9	.022/20.9	.023/20.9	.024/20.9	.025/20.9	.025/20.9	.024/20.9	.023/20.9	.022/20.9	.021/20.9	.020/20.9
5	7	.017/ 8.5	.018/ 8.5	.018/ 8.5	.018/ 8.5	.018/ 8.5	.017/ 8.3	.016/ 8.1	.014/ 8.1	.012/ 7.3	.010/ 6.3	.009/ 5.7	.008/ 5.7	.007/ 5.7
	9	.017/ 9.2	.017/ 9.2	.018/ 9.2	.018/ 9.0	.018/ 8.5	.017/ 8.5	.016/ 8.5	.014/ 8.5	.012/ 8.5	.011/ 8.7	.009/ 8.7	.008/ 6.3	.007/ 6.3
	11	.016/ 9.2	.016/ 9.2	.016/ 9.2	.016/ 9.2	.016/ 9.2	.016/ 9.2	.015/ 9.2	.013/ 9.5	.012/ 9.8	.010/ 9.8	.008/ 9.5	.007/ 9.2	.007/ 9.0
	13	.015/14.3	.015/14.3	.015/14.0	.015/ 9.2	.015/ 9.2	.014/11.2	.013/10.8	.012/10.8	.011/10.8	.009/10.5	.008/10.1	.006/ 9.8	.006/ 9.5
	15	.025/22.4	.025/21.7	.025/21.7	.024/21.7	.024/21.7	.022/21.7	.019/21.7	.016/21.7	.012/21.7	.009/21.7	.007/10.8	.006/10.5	.005/10.1
	17	.042/22.4	.043/22.4	.043/22.4	.043/22.4	.042/21.7	.039/21.7	.033/21.7	.026/21.7	.019/21.7	.012/21.7	.008/20.9	.006/20.3	.005/20.3
	19	.056/22.4	.057/22.4	.058/22.4	.058/22.4	.057/22.4	.052/21.7	.045/21.7	.035/21.7	.025/21.7	.015/21.7	.009/20.9	.006/20.3	.005/20.3
	21	.063/22.4	.064/22.4	.065/22.4	.066/22.4	.064/22.4	.059/21.7	.051/21.7	.040/21.7	.028/21.7	.016/21.7	.009/20.9	.006/20.3	.005/20.3
10	7	.032/12.8	.031/12.8	.030/12.8	.029/11.6	.027/11.6	.024/11.6	.021/11.6	.016/10.1	.012/10.1	.009/ 6.8	.007/ 6.8	.006/ 4.8	.005/ 4.8
	9	.031/12.8	.030/12.8	.029/12.8	.028/12.8	.026/11.6	.023/11.6	.020/11.6	.016/10.1	.013/10.1	.010/ 8.3	.008/ 8.3	.006/ 8.3	.005/ 5.2
	11	.028/12.8	.028/12.8	.027/12.8	.026/12.8	.024/11.6	.021/11.6	.018/11.6	.015/10.1	.012/10.1	.009/ 9.8	.007/ 9.8	.006/ 9.2	.005/ 8.5
	13	.031/22.4	.030/22.4	.029/22.4	.027/22.4	.025/22.4	.022/22.4	.019/22.4	.015/11.6	.011/10.1	.009/10.8	.007/10.5	.005/10.5	.004/ 9.0
	15	.045/22.4	.045/22.4	.043/22.4	.040/22.4	.037/22.4	.032/22.4	.027/22.4	.020/21.7	.015/21.7	.010/21.7	.007/14.6	.005/15.3	.004/15.3
	17	.060/22.4	.060/22.4	.059/22.4	.056/22.4	.053/22.4	.047/22.4	.040/22.4	.031/21.7	.023/21.7	.015/21.7	.009/21.7	.005/16.1	.004/16.5
	19	.067/22.4	.067/22.4	.067/22.4	.066/22.4	.063/22.4	.058/22.4	.050/22.4	.040/21.7	.030/21.7	.020/21.7	.011/21.7	.005/17.0	.004/17.0
	21	.068/22.4	.068/22.4	.069/22.4	.069/22.4	.067/22.4	.062/22.4	.054/22.4	.044/21.7	.033/21.7	.022/21.7	.012/21.7	.005/17.5	.004/17.5
15	7	.151/21.7	.147/21.7	.136/21.7	.118/21.7	.097/20.9	.075/20.9	.051/18.5	.038/18.5	.017/14.3	.009/10.1	.007/ 7.1	.005/ 4.5	.004/ 4.5
	9	.134/20.9	.131/20.9	.120/20.9	.104/20.9	.084/20.9	.064/20.9	.043/18.5	.032/18.5	.016/14.3	.010/10.1	.007/ 8.3	.005/ 8.3	.004/ 4.5
	11	.108/20.9	.105/20.9	.096/20.9	.084/20.9	.068/20.9	.052/20.9	.035/18.5	.027/18.0	.015/14.3	.010/10.1	.007/ 9.8	.005/ 9.8	.004/10.1
	13	.098/22.4	.096/22.4	.088/22.4	.077/22.4	.063/22.4	.049/22.4	.034/22.4	.027/22.4	.015/22.4	.009/10.1	.007/10.8	.005/10.8	.004/10.8
	15	.100/22.4	.097/22.4	.091/22.4	.081/22.4	.068/22.4	.055/22.4	.040/22.4	.035/22.4	.020/22.4	.012/22.4	.007/22.4	.005/14.6	.004/15.0
	17	.099/22.4	.097/22.4	.091/22.4	.083/22.4	.073/22.4	.061/22.4	.047/22.4	.044/22.4	.028/22.4	.017/22.4	.009/22.4	.005/16.1	.004/16.1
	19	.093/22.4	.092/22.4	.088/22.4	.082/22.4	.073/22.4	.063/22.4	.050/22.4	.050/22.4	.034/22.4	.021/22.4	.011/22.4	.005/17.0	.004/17.0
	21	.085/22.4	.084/22.4	.081/22.4	.077/22.4	.070/22.4	.061/22.4	.050/22.4	.052/22.4	.036/22.4	.023/22.4	.012/22.4	.005/17.5	.004/17.5
20	7	.217/22.4	.217/22.4	.216/22.4	.216/22.4	.208/22.4	.186/22.4	.152/22.4	.203/22.4	.105/22.4	.011/13.4	.006/ 7.3	.004/ 6.8	.003/ 3.9
	9	.199/23.3	.198/23.3	.196/22.4	.192/22.4	.183/22.4	.163/22.4	.131/22.4	.172/22.4	.088/22.4	.011/13.4	.007/ 8.1	.005/ 8.1	.004/ 7.9
	11	.182/23.3	.181/23.3	.175/23.3	.168/23.3	.156/23.3	.136/23.3	.108/23.3	.137/22.4	.067/22.4	.011/13.4	.007/ 9.5	.005/ 9.8	.004/ 9.8
	13	.164/23.3	.162/23.3	.156/23.3	.147/23.3	.135/23.3	.117/23.3	.091/23.3	.112/22.4	.054/22.4	.011/22.4	.007/10.5	.005/10.5	.004/10.5
	15	.143/23.3	.141/23.3	.136/23.3	.128/23.3	.117/23.3	.101/23.3	.079/23.3	.098/22.4	.048/22.4	.014/22.4	.007/22.4	.005/14.0	.004/14.6
	17	.123/23.3	.122/23.3	.117/23.3	.111/23.3	.102/23.3	.088/23.3	.069/23.3	.088/22.4	.046/22.4	.017/22.4	.009/22.4	.006/15.7	.005/15.7
	19	.105/23.3	.104/23.3	.101/23.3	.096/23.3	.089/23.3	.077/23.3	.061/23.3	.079/22.4	.044/22.4	.020/22.4	.010/22.4	.006/16.5	.005/16.5
	21	.090/23.3	.089/23.3	.087/23.3	.083/23.3	.077/23.3	.068/23.3	.054/23.3	.071/22.4	.041/22.4	.020/22.4	.010/22.4	.006/16.5	.005/16.5

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 5 - SHIP A, ROOT MEAN SQUARE PITCH RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP A (SPHERICAL TANKS)

RMS PITCH IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.030/ 8.7	.031/ 8.7	.033/ 8.1	.036/ 8.1	.039/ 8.1	.041/ 8.1	.041/ 8.1	.040/ 8.1	.038/ 8.1	.035/ 8.1	.032/ 8.5	.030/ 8.7	.029/ 8.7
	9	.053/ 9.8	.054/ 9.8	.054/ 9.8	.056/ 9.5	.056/ 9.2	.057/ 9.0	.057/ 8.7	.056/ 9.0	.056/ 9.2	.054/ 9.5	.053/ 9.8	.053/ 9.8	.052/ 9.8
	11	.066/10.8	.066/10.8	.064/10.8	.063/10.5	.061/10.5	.060/10.1	.059/ 9.8	.060/10.1	.061/10.5	.062/10.5	.064/10.8	.065/10.8	.065/10.8
	13	.069/12.1	.068/12.1	.066/11.6	.063/11.6	.059/11.2	.057/11.2	.056/10.8	.057/11.2	.059/11.2	.062/11.6	.066/11.6	.068/12.1	.069/12.1
	15	.066/12.8	.065/12.8	.063/12.8	.059/12.6	.055/12.6	.051/12.1	.050/12.1	.051/12.1	.055/12.8	.059/12.8	.063/13.1	.065/13.1	.066/13.1
	17	.061/13.7	.060/13.7	.058/13.7	.054/13.7	.049/13.4	.046/13.4	.045/13.1	.046/13.4	.049/13.7	.054/13.7	.058/14.0	.060/14.0	.061/14.0
	19	.055/15.0	.054/15.0	.052/15.0	.048/14.6	.044/14.3	.040/14.3	.039/14.3	.040/14.3	.044/14.3	.048/14.6	.052/15.0	.055/15.0	.056/15.0
	21	.049/16.1	.048/16.1	.046/16.1	.042/15.7	.039/15.3	.035/15.3	.034/15.0	.035/15.3	.039/15.3	.043/15.7	.046/15.7	.049/16.1	.050/16.1
5	7	.029/ 8.5	.030/ 8.5	.033/ 8.5	.036/ 8.5	.039/ 8.3	.041/ 7.9	.040/ 7.9	.039/ 7.7	.036/ 7.7	.032/ 7.7	.029/ 7.9	.026/ 7.9	.025/ 7.9
	9	.047/11.6	.048/11.6	.049/11.6	.051/11.2	.053/ 9.5	.055/ 8.5	.056/ 8.5	.057/ 8.5	.057/ 8.5	.056/ 8.5	.056/ 8.7	.055/ 8.7	.055/ 8.7
	11	.059/12.8	.059/12.8	.058/12.6	.058/12.6	.057/12.1	.058/11.2	.059/ 9.5	.061/ 9.2	.064/ 9.2	.067/ 9.2	.069/ 9.5	.071/ 9.5	.072/ 9.5
	13	.062/13.7	.061/13.7	.060/13.7	.058/13.4	.055/13.1	.055/12.6	.056/10.8	.058/10.1	.063/10.1	.067/10.1	.071/10.1	.074/10.5	.075/10.5
	15	.060/14.6	.060/14.6	.057/14.6	.054/14.6	.051/14.0	.050/13.4	.050/12.6	.053/11.2	.058/10.8	.063/10.8	.068/11.2	.071/11.2	.072/11.2
	17	.057/15.7	.056/15.7	.053/15.7	.050/15.3	.046/15.0	.044/14.6	.045/13.4	.047/12.6	.052/12.1	.057/12.1	.062/12.6	.065/12.6	.066/12.6
	19	.051/16.5	.051/16.5	.048/16.5	.045/16.1	.041/16.1	.039/15.3	.039/14.3	.042/13.4	.046/13.4	.051/13.4	.056/13.4	.059/13.4	.060/13.4
	21	.046/17.5	.045/17.5	.043/17.5	.040/17.5	.037/17.0	.034/16.5	.034/15.3	.037/14.6	.041/14.0	.045/14.3	.049/14.3	.052/14.3	.053/14.3
10	7	.024/12.8	.026/12.8	.030/12.8	.034/ 9.5	.038/ 9.5	.039/ 7.5	.039/ 7.5	.038/ 7.5	.034/ 7.3	.030/ 7.3	.026/ 7.3	.023/ 7.3	.022/ 7.3
	9	.041/14.6	.042/14.6	.044/14.6	.047/14.6	.050/11.6	.053/ 8.1	.055/ 7.9	.056/ 7.9	.057/ 7.9	.057/ 7.9	.056/ 8.1	.056/ 8.1	.056/ 8.1
	11	.053/15.3	.053/15.3	.053/15.3	.053/15.0	.054/15.0	.056/14.3	.059/ 8.5	.062/ 8.3	.066/ 8.5	.070/ 8.5	.073/ 8.5	.075/ 8.5	.076/ 8.5
	13	.057/16.1	.056/16.1	.055/16.1	.053/15.7	.052/15.7	.053/15.0	.056/ 9.5	.060/ 9.2	.066/ 9.2	.071/ 9.2	.076/ 9.2	.079/ 9.2	.081/ 9.2
	15	.056/17.0	.055/17.0	.053/17.0	.051/16.5	.049/16.5	.048/15.7	.050/13.7	.055/ 9.8	.061/ 9.8	.067/ 9.8	.073/ 9.8	.076/ 9.8	.077/ 9.8
	17	.053/18.0	.052/18.0	.050/17.5	.047/17.5	.044/17.0	.043/16.5	.045/15.0	.049/10.8	.055/10.5	.061/10.5	.066/10.5	.070/10.5	.071/10.5
	19	.048/18.5	.048/18.5	.045/18.5	.042/18.5	.040/18.0	.038/17.0	.039/15.7	.043/13.1	.048/11.6	.054/11.2	.059/11.2	.062/11.2	.064/11.2
	21	.043/19.6	.043/19.6	.041/19.6	.038/19.0	.035/19.0	.034/18.5	.034/16.5	.038/14.0	.043/13.1	.048/12.8	.052/12.8	.055/12.8	.056/12.8
15	7	.021/14.3	.024/14.3	.028/14.3	.033/11.2	.037/11.2	.039/ 7.5	.039/ 7.5	.037/ 7.5	.033/ 7.3	.028/ 7.1	.023/ 7.0	.020/ 7.0	.018/ 7.0
	9	.037/17.5	.038/17.5	.041/17.5	.044/17.5	.048/17.5	.052/ 7.7	.054/ 7.5	.056/ 7.5	.056/ 7.5	.056/ 7.5	.055/ 7.5	.054/ 7.5	.054/ 7.5
	11	.049/20.3	.049/20.3	.049/20.3	.050/19.6	.052/17.5	.055/17.5	.059/ 7.9	.064/ 7.9	.068/ 7.9	.072/ 7.9	.075/ 7.9	.077/ 7.9	.078/ 7.9
	13	.053/20.3	.053/20.3	.052/20.3	.051/20.3	.051/20.3	.052/17.5	.056/ 8.1	.062/ 8.1	.069/ 8.1	.075/ 8.3	.080/ 8.3	.083/ 8.3	.084/ 8.3
	15	.053/20.3	.052/20.3	.051/20.3	.048/20.3	.047/20.3	.048/19.6	.051/ 8.3	.057/ 8.5	.064/ 8.7	.071/ 8.7	.076/ 9.0	.080/ 9.0	.082/ 9.0
	17	.050/20.3	.049/20.3	.048/20.3	.045/20.3	.043/20.3	.043/20.3	.045/17.5	.051/ 9.2	.057/ 9.2	.064/ 9.2	.070/ 9.5	.074/ 9.5	.075/ 9.5
	19	.046/20.3	.045/20.3	.043/20.3	.041/20.3	.038/20.3	.038/20.3	.040/17.5	.045/ 9.8	.051/ 9.8	.057/ 9.8	.062/10.1	.066/10.1	.067/10.1
	21	.042/20.9	.041/20.9	.039/20.9	.036/20.9	.034/20.9	.033/20.3	.035/17.5	.039/12.6	.044/11.2	.050/10.8	.055/10.8	.058/10.8	.059/10.8
20	7	.022/13.4	.024/13.4	.028/13.4	.032/13.4	.035/13.4	.037/13.4	.037/13.4	.035/13.4	.031/ 7.0	.026/ 7.0	.021/ 6.8	.017/ 6.7	.015/ 6.7
	9	.036/23.3	.037/23.3	.039/19.0	.043/19.0	.047/19.0	.051/13.4	.053/ 7.3	.055/ 7.3	.055/ 7.3	.054/ 7.3	.053/ 7.3	.052/ 7.3	.051/ 7.3
	11	.046/23.3	.046/23.3	.047/23.3	.048/23.3	.051/19.0	.055/19.0	.059/ 7.5	.065/ 7.5	.069/ 7.5	.074/ 7.5	.077/ 7.5	.078/ 7.5	.079/ 7.5
	13	.051/23.3	.050/23.3	.050/23.3	.049/23.3	.050/23.3	.052/23.3	.057/ 7.7	.064/ 7.7	.071/ 7.7	.078/ 7.7	.083/ 7.7	.087/ 7.7	.088/ 7.7
	15	.051/26.2	.050/26.2	.049/26.2	.047/23.3	.046/23.3	.048/23.3	.052/19.0	.059/ 7.9	.067/ 7.9	.074/ 7.9	.080/ 7.9	.084/ 7.9	.085/ 7.9
	17	.049/26.2	.048/26.2	.046/26.2	.044/26.2	.042/23.3	.043/23.3	.046/23.3	.053/ 7.9	.060/ 7.9	.067/ 7.9	.073/ 7.9	.077/ 8.1	.079/ 8.1
	19	.045/26.2	.044/26.2	.042/26.2	.040/26.2	.038/26.2	.038/23.3	.041/23.3	.046/ 7.9	.053/ 8.1	.060/ 8.1	.065/ 8.1	.069/ 8.1	.070/ 8.3
	21	.041/27.3	.040/27.3	.038/27.3	.036/26.2	.034/26.2	.033/23.3	.036/23.3	.040/ 8.1	.046/ 8.1	.052/ 8.1	.058/ 9.2	.061/ 9.5	.062/ 9.5

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 6 - SHIP A, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP A (SPHERICAL TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.027/ 7.3	.028/ 7.3	.030/ 7.3	.034/ 7.3	.037/ 7.3	.039/ 7.1	.039/ 7.1	.039/ 7.3	.037/ 7.3	.035/ 7.3	.032/ 7.3	.030/ 7.3	.029/ 7.3
	9	.038/10.5	.039/10.5	.040/10.5	.042/10.5	.044/10.1	.045/ 9.8	.046/ 9.5	.046/ 9.8	.045/10.1	.044/10.5	.042/10.5	.041/10.5	.041/10.5
	11	.051/12.1	.051/12.1	.050/11.6	.049/11.6	.049/11.6	.048/11.2	.048/11.2	.049/11.2	.050/11.2	.051/11.6	.052/11.6	.053/11.6	.054/11.6
	13	.059/13.1	.058/13.1	.057/12.8	.054/12.8	.051/12.8	.049/12.6	.048/12.1	.049/12.6	.052/12.6	.055/12.8	.058/12.8	.060/12.8	.061/12.8
	15	.062/14.3	.061/14.3	.058/14.3	.055/14.0	.050/14.0	.047/13.7	.046/13.4	.048/13.4	.051/13.7	.055/14.0	.059/14.0	.062/14.0	.063/14.0
	17	.061/15.3	.060/15.3	.057/15.3	.053/15.0	.048/15.0	.044/15.0	.043/14.6	.045/14.6	.048/15.0	.053/15.0	.058/15.0	.061/15.0	.062/15.0
	19	.057/16.1	.056/16.1	.053/16.1	.049/16.1	.044/16.1	.040/16.1	.039/16.1	.041/16.1	.044/16.1	.049/16.1	.054/16.1	.057/16.1	.058/16.1
	21	.052/17.5	.051/17.5	.048/17.5	.044/17.5	.040/17.5	.036/17.0	.035/17.0	.036/17.0	.040/17.0	.045/17.5	.049/17.5	.051/17.5	.052/17.5
5	7	.023/ 9.2	.025/ 9.2	.027/ 9.2	.031/ 7.1	.035/ 7.1	.038/ 7.1	.039/ 7.1	.039/ 7.0	.038/ 7.0	.036/ 7.0	.033/ 6.3	.031/ 6.3	.030/ 6.3
	9	.036/12.6	.037/12.6	.038/12.1	.040/12.1	.042/11.6	.045/10.1	.046/ 7.9	.047/ 7.9	.047/ 8.1	.046/ 8.7	.045/ 9.0	.044/ 9.0	.043/ 9.0
	11	.051/13.7	.051/13.4	.050/13.4	.049/13.4	.048/13.1	.048/12.6	.049/11.6	.050/10.8	.051/10.5	.053/10.5	.054/10.5	.055/10.5	.055/10.5
	13	.060/14.6	.059/14.6	.057/14.6	.054/14.3	.051/14.0	.049/13.7	.049/12.8	.050/12.1	.052/11.6	.056/11.6	.059/11.6	.061/11.6	.061/11.6
	15	.062/15.7	.061/15.7	.059/15.7	.055/15.3	.051/15.3	.047/14.6	.046/14.0	.048/13.1	.051/12.8	.056/12.8	.059/12.8	.062/12.8	.063/12.8
	17	.061/16.5	.060/16.5	.057/16.5	.053/16.5	.048/16.1	.044/15.7	.043/15.0	.045/14.3	.048/14.0	.053/14.0	.057/14.0	.060/14.0	.061/14.0
	19	.057/18.0	.056/18.0	.053/18.0	.049/17.5	.044/17.5	.041/17.0	.039/16.1	.041/15.3	.044/15.0	.049/15.0	.053/15.3	.056/15.3	.057/15.3
	21	.052/19.0	.051/19.0	.049/18.5	.045/18.5	.040/18.5	.036/18.0	.035/17.0	.036/16.5	.040/16.1	.044/16.1	.048/16.1	.051/16.1	.052/16.1
10	7	.022/12.8	.023/12.8	.026/12.8	.030/12.8	.034/ 6.8	.037/ 6.8	.039/ 6.7	.039/ 6.7	.039/ 6.7	.036/ 6.7	.034/ 6.8	.032/ 6.8	.031/ 7.0
	9	.036/15.0	.037/15.0	.038/15.0	.040/13.4	.042/13.4	.045/12.8	.047/ 7.3	.049/ 7.3	.049/ 7.3	.049/ 7.5	.048/ 7.5	.047/ 7.5	.047/ 7.5
	11	.051/15.7	.051/15.7	.050/15.7	.049/15.7	.049/15.3	.049/15.0	.050/13.7	.052/ 7.7	.054/ 7.7	.056/ 9.0	.057/ 9.0	.058/ 9.2	.058/ 9.2
	13	.060/17.0	.059/16.5	.057/16.5	.054/16.5	.051/16.1	.050/15.7	.049/14.6	.051/11.6	.054/10.8	.058/10.8	.061/10.8	.063/10.8	.064/10.8
	15	.063/17.5	.062/17.5	.059/17.5	.055/17.5	.051/17.0	.048/16.5	.047/15.3	.049/12.8	.052/12.1	.057/12.1	.061/11.6	.063/11.6	.064/11.6
	17	.062/18.5	.060/18.5	.057/18.5	.053/18.5	.048/18.0	.045/17.5	.043/16.1	.045/14.3	.049/13.4	.054/12.8	.058/12.8	.061/12.8	.062/12.8
	19	.058/19.6	.057/19.6	.054/19.0	.049/19.0	.045/19.0	.041/18.5	.039/17.0	.041/15.3	.045/14.3	.049/14.3	.054/14.0	.057/14.0	.058/14.0
	21	.053/20.3	.052/20.3	.049/20.3	.045/20.3	.040/19.6	.037/19.0	.035/18.0	.037/16.5	.040/15.7	.045/15.3	.049/15.3	.051/15.3	.052/15.3
15	7	.021/17.5	.022/17.5	.025/17.5	.029/17.5	.033/14.3	.036/ 6.8	.038/ 6.4	.039/ 6.4	.038/ 6.4	.037/ 6.4	.034/ 6.4	.032/ 6.4	.031/ 6.4
	9	.036/17.5	.037/17.5	.038/17.5	.040/17.5	.042/17.5	.046/17.5	.049/ 7.0	.051/ 7.0	.052/ 7.0	.053/ 7.0	.052/ 7.0	.052/ 7.0	.051/ 7.0
	11	.052/20.3	.051/20.3	.050/20.3	.049/20.3	.049/19.6	.050/17.5	.052/15.3	.054/ 7.1	.057/ 7.3	.060/ 7.3	.062/ 7.3	.063/ 7.3	.063/ 7.3
	13	.060/20.3	.060/20.3	.057/20.3	.055/20.3	.052/20.3	.050/19.6	.051/18.0	.053/ 7.3	.057/ 7.3	.061/ 7.5	.064/ 7.5	.067/ 7.5	.067/ 7.5
	15	.063/20.3	.062/20.3	.059/20.3	.055/20.3	.051/20.3	.048/20.3	.048/18.0	.050/12.1	.054/11.2	.059/11.2	.063/11.2	.066/11.2	.067/11.2
	17	.062/20.9	.061/20.9	.058/20.9	.053/20.9	.049/20.3	.045/20.3	.044/19.6	.046/13.4	.050/12.6	.055/12.1	.059/12.1	.063/12.1	.064/12.1
	19	.058/21.7	.057/21.7	.054/21.7	.050/21.7	.045/20.9	.041/20.9	.040/19.6	.042/15.7	.046/13.7	.050/13.4	.055/13.4	.058/13.1	.059/13.1
	21	.053/22.4	.052/22.4	.049/22.4	.045/21.7	.040/21.7	.037/21.7	.036/17.5	.037/16.5	.041/15.0	.045/14.6	.049/14.6	.052/14.6	.053/14.6
20	7	.020/13.4	.021/13.4	.023/13.4	.027/13.4	.031/13.4	.035/13.4	.037/13.4	.038/ 6.3	.038/ 6.3	.036/ 6.3	.034/ 6.3	.032/ 6.3	.031/ 6.3
	9	.036/23.3	.036/23.3	.037/23.3	.039/19.0	.042/19.0	.046/19.0	.050/19.0	.052/ 6.7	.054/ 6.7	.055/ 6.7	.055/ 6.7	.055/ 6.7	.055/ 6.7
	11	.052/23.3	.051/23.3	.050/23.3	.049/23.3	.049/23.3	.051/19.0	.053/19.0	.057/ 7.0	.060/ 7.0	.064/ 7.0	.067/ 7.0	.068/ 7.0	.069/ 7.0
	13	.060/23.3	.060/23.3	.057/23.3	.055/23.3	.052/23.3	.051/23.3	.052/19.0	.055/ 7.0	.060/ 7.0	.064/ 7.0	.068/ 7.0	.071/ 7.0	.072/ 7.0
	15	.063/26.2	.062/26.2	.059/26.2	.055/26.2	.051/23.3	.049/23.3	.049/23.3	.051/19.0	.056/ 7.1	.061/ 7.1	.066/ 7.1	.069/ 7.1	.070/ 7.1
	17	.062/26.2	.061/26.2	.058/26.2	.053/26.2	.049/23.3	.045/23.3	.045/23.3	.047/19.0	.052/11.6	.057/11.6	.062/11.6	.065/11.6	.066/11.6
	19	.058/26.2	.057/26.2	.054/26.2	.050/26.2	.045/26.2	.041/23.3	.040/23.3	.042/14.6	.047/13.4	.052/12.6	.056/12.6	.059/12.6	.060/12.6
	21	.053/27.3	.052/27.3	.049/27.3	.045/27.3	.040/26.2	.037/23.3	.036/23.3	.038/15.3	.042/14.6	.046/14.0	.050/13.7	.053/13.7	.054/13.7

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 7 - SHIP A, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP A (SPHERICAL TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{0E}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.039/ 8.3	.051/ 8.1	.077/ 7.5	.105/ 7.5	.129/ 7.3	.146/ 7.3	.154/ 7.3	.153/ 7.1	.142/ 7.1	.122/ 7.1	.097/ 7.0	.070/ 7.1	.056/ 7.3
	9	.059/ 9.5	.070/ 9.5	.095/ 9.2	.123/ 9.0	.146/ 8.7	.162/ 8.7	.169/ 8.7	.166/ 8.7	.154/ 8.7	.133/ 8.7	.107/ 9.0	.081/ 9.2	.068/ 9.5
	11	.068/10.5	.077/10.5	.099/10.5	.123/10.1	.144/10.1	.158/ 9.8	.164/ 9.8	.161/ 9.8	.149/10.1	.129/10.1	.106/10.5	.083/10.5	.073/10.5
	13	.069/11.6	.076/11.6	.094/11.6	.115/11.2	.133/11.2	.146/11.2	.150/11.2	.147/11.2	.137/11.2	.120/11.2	.099/11.6	.080/11.6	.072/11.6
	15	.065/12.8	.071/12.8	.087/12.6	.105/12.6	.120/12.6	.131/12.6	.135/12.6	.132/12.6	.123/12.6	.108/12.8	.090/12.8	.075/13.1	.068/13.1
	17	.060/13.7	.065/13.7	.078/13.7	.094/13.4	.107/13.4	.116/13.7	.120/13.7	.117/13.7	.109/13.7	.096/14.0	.081/14.0	.068/14.3	.062/14.3
	19	.054/15.3	.058/15.0	.070/15.0	.083/15.0	.095/15.0	.103/15.0	.106/15.0	.103/15.0	.096/15.0	.085/15.0	.072/15.0	.061/15.3	.056/15.3
	21	.048/16.1	.052/16.1	.061/16.1	.073/16.1	.083/16.1	.090/16.1	.093/16.1	.091/16.1	.084/16.1	.075/16.1	.064/16.1	.054/16.1	.049/16.1
5	7	.037/ 9.2	.049/ 8.5	.076/ 7.9	.105/ 7.3	.130/ 7.1	.148/ 7.1	.157/ 7.0	.157/ 7.0	.146/ 7.0	.128/ 6.8	.102/ 6.7	.076/ 6.7	.062/ 6.7
	9	.055/10.8	.066/10.5	.092/ 9.8	.120/ 9.2	.145/ 9.0	.163/ 8.7	.171/ 8.7	.170/ 8.5	.158/ 8.5	.138/ 8.3	.112/ 8.3	.086/ 8.5	.073/ 8.5
	11	.063/12.1	.073/11.6	.094/11.2	.120/10.8	.142/10.5	.157/10.1	.165/10.1	.163/ 9.8	.152/ 9.5	.134/ 9.5	.111/ 9.5	.088/ 9.5	.078/ 9.8
	13	.064/13.1	.072/12.8	.090/12.6	.112/12.1	.131/11.6	.145/11.6	.151/11.2	.149/10.8	.140/10.8	.124/10.8	.103/10.8	.085/10.8	.076/10.8
	15	.061/14.0	.067/13.7	.083/13.4	.101/13.4	.118/12.8	.130/12.8	.135/12.6	.134/12.6	.125/12.1	.111/12.1	.094/12.1	.078/12.1	.072/12.1
	17	.056/15.3	.061/15.0	.075/15.0	.091/14.3	.105/14.0	.115/14.0	.120/13.7	.119/13.4	.111/13.4	.099/13.4	.085/13.4	.071/13.4	.065/13.4
	19	.050/16.1	.055/16.1	.067/15.7	.080/15.7	.093/15.3	.102/15.3	.106/15.0	.105/15.0	.098/14.6	.088/14.6	.075/14.6	.064/14.3	.059/14.3
	21	.045/17.0	.049/17.0	.059/17.0	.071/16.5	.081/16.5	.089/16.1	.093/16.1	.092/15.7	.086/15.7	.077/15.7	.066/15.7	.056/15.3	.052/15.3
10	7	.033/10.1	.046/ 9.5	.073/ 7.7	.103/ 7.5	.129/ 7.3	.148/ 6.7	.159/ 6.7	.159/ 6.7	.149/ 6.5	.131/ 6.5	.106/ 6.5	.079/ 6.4	.065/ 6.3
	9	.051/12.1	.062/11.6	.088/10.1	.117/ 9.8	.143/ 9.2	.162/ 8.5	.172/ 8.3	.172/ 8.3	.162/ 8.1	.142/ 7.9	.117/ 7.9	.090/ 7.7	.078/ 7.7
	11	.058/13.7	.067/13.4	.090/12.6	.116/11.6	.139/10.8	.156/10.1	.165/ 9.8	.165/ 9.5	.155/ 9.2	.138/ 9.0	.115/ 9.0	.093/ 9.0	.082/ 9.0
	13	.058/15.0	.066/14.6	.085/14.0	.108/13.1	.128/12.6	.143/12.1	.151/11.2	.151/10.8	.142/10.5	.127/10.1	.107/10.1	.089/10.1	.080/ 9.8
	15	.056/15.7	.062/15.3	.078/15.0	.098/14.3	.115/13.7	.129/13.1	.135/12.8	.135/12.6	.128/12.1	.115/11.6	.098/11.2	.082/11.2	.075/11.2
	17	.051/16.5	.057/16.5	.071/16.1	.087/15.3	.103/15.0	.114/14.3	.120/14.0	.120/13.4	.114/13.4	.102/12.8	.088/12.8	.074/12.6	.069/12.6
	19	.046/18.0	.051/17.5	.063/17.0	.077/16.1	.091/16.1	.101/15.3	.106/15.3	.106/14.6	.100/14.6	.090/14.0	.078/14.0	.066/13.7	.061/13.7
	21	.041/19.6	.045/19.0	.056/18.5	.068/17.5	.080/17.0	.088/16.5	.093/16.1	.092/15.7	.088/15.3	.079/15.3	.068/15.0	.059/14.6	.054/14.6
15	7	.032/14.3	.045/14.3	.072/ 8.5	.102/ 6.5	.129/ 6.5	.149/ 6.4	.160/ 6.4	.160/ 6.3	.151/ 6.3	.133/ 6.3	.108/ 6.3	.081/ 5.7	.066/ 5.7
	9	.047/14.6	.058/14.6	.084/11.6	.115/ 9.2	.142/ 9.0	.162/ 8.5	.173/ 8.3	.174/ 8.1	.164/ 7.5	.146/ 7.3	.120/ 7.3	.094/ 7.1	.081/ 7.0
	11	.053/17.5	.063/17.5	.085/14.6	.112/12.1	.137/11.6	.155/ 9.8	.166/ 9.5	.167/ 9.0	.158/ 9.0	.141/ 8.7	.119/ 8.5	.096/ 8.3	.086/ 8.3
	13	.053/17.5	.062/17.5	.081/15.0	.104/14.6	.126/12.6	.142/12.1	.151/11.2	.152/10.5	.145/10.1	.130/ 9.8	.111/ 9.5	.092/ 9.2	.084/ 9.2
	15	.051/17.5	.058/17.5	.074/17.5	.094/15.3	.113/14.6	.127/13.1	.135/12.6	.136/12.1	.130/11.6	.117/11.2	.101/10.8	.085/10.5	.078/10.1
	17	.047/19.6	.053/19.6	.067/17.5	.084/17.5	.101/15.3	.113/15.0	.120/14.3	.121/13.4	.115/13.1	.105/12.6	.090/12.1	.077/11.6	.071/11.6
	19	.042/20.9	.047/19.6	.060/19.6	.075/17.5	.089/17.5	.100/15.7	.106/15.3	.106/14.6	.102/14.3	.092/13.7	.080/13.4	.069/13.1	.064/13.1
	21	.038/21.7	.042/20.9	.053/20.9	.066/19.6	.078/17.5	.087/17.5	.093/16.1	.093/15.7	.089/15.3	.081/14.6	.070/14.6	.061/14.0	.057/14.0
20	7	.034/22.4	.045/22.4	.072/13.4	.103/13.4	.130/ 6.4	.150/ 6.3	.161/ 6.3	.162/ 6.3	.153/ 5.7	.135/ 5.7	.109/ 5.7	.082/ 5.7	.067/ 5.2
	9	.043/19.0	.054/19.0	.081/13.4	.112/13.4	.141/ 9.5	.162/ 7.5	.174/ 7.3	.176/ 7.1	.167/ 7.0	.148/ 7.0	.123/ 6.8	.097/ 6.7	.084/ 6.5
	11	.046/19.0	.056/19.0	.080/19.0	.109/13.4	.135/10.5	.155/ 9.8	.166/ 9.5	.168/ 9.0	.161/ 8.5	.144/ 8.3	.122/ 8.1	.100/ 7.9	.089/ 7.7
	13	.046/19.0	.054/19.0	.076/19.0	.100/19.0	.123/13.4	.141/11.2	.152/10.8	.154/10.1	.147/ 9.8	.133/ 9.5	.114/ 9.0	.095/ 8.7	.087/ 8.7
	15	.043/19.0	.051/19.0	.069/19.0	.091/19.0	.111/14.3	.126/13.4	.136/13.4	.138/11.6	.132/11.2	.120/10.5	.104/10.1	.088/ 9.8	.081/ 9.8
	17	.040/19.0	.047/19.0	.063/19.0	.081/19.0	.098/19.0	.112/14.6	.120/14.0	.122/13.4	.117/13.4	.107/12.1	.093/11.2	.080/10.8	.074/10.8
	19	.037/19.0	.042/19.0	.056/19.0	.072/19.0	.087/19.0	.099/15.7	.106/15.3	.107/14.6	.103/14.0	.094/13.4	.082/12.8	.071/12.6	.066/12.1
	21	.033/21.7	.038/20.9	.049/19.0	.063/19.0	.076/19.0	.086/19.0	.093/16.1	.094/15.7	.090/15.0	.083/14.6	.072/14.0	.063/13.4	.058/13.4

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 8 - SHIP A, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP A (SPHERICAL TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.157/ 7.5	.171/ 7.5	.204/ 7.5	.242/ 7.5	.276/ 7.5	.300/ 7.5	.311/ 7.5	.308/ 7.5	.291/ 7.5	.263/ 7.5	.231/ 7.5	.204/ 7.5	.193/ 7.5
	9	.216/ 9.2	.229/ 9.2	.261/ 8.7	.299/ 8.3	.334/ 8.1	.359/ 8.1	.371/ 8.1	.367/ 8.1	.348/ 8.1	.319/ 8.3	.286/ 8.3	.259/ 8.7	.248/ 9.0
	11	.227/10.1	.236/10.1	.260/ 9.8	.289/ 9.2	.316/ 8.7	.336/ 8.7	.345/ 8.7	.342/ 8.7	.327/ 8.7	.305/ 9.0	.279/ 9.5	.259/ 9.8	.251/ 9.8
	13	.214/10.8	.220/10.8	.237/10.5	.257/10.1	.277/ 9.5	.292/ 9.0	.298/ 9.0	.296/ 9.0	.286/ 9.2	.269/ 9.8	.251/10.5	.237/10.5	.232/10.5
	15	.193/11.6	.197/11.6	.209/11.2	.224/10.8	.238/10.1	.249/ 9.5	.254/ 9.2	.252/ 9.5	.245/ 9.8	.233/10.5	.220/11.2	.210/11.2	.206/11.2
	17	.170/12.6	.173/12.1	.182/12.1	.193/11.6	.203/11.2	.212/10.1	.215/ 9.5	.214/ 9.8	.209/10.8	.200/11.2	.190/12.1	.183/12.1	.180/12.1
	19	.149/13.1	.151/13.1	.158/12.8	.166/12.6	.174/12.1	.181/10.8	.184/10.1	.183/10.8	.178/11.6	.172/12.8	.164/13.1	.159/13.4	.157/13.4
	21	.130/13.7	.131/13.7	.136/13.7	.143/13.4	.150/13.4	.155/13.1	.157/12.8	.156/13.1	.153/13.4	.148/13.7	.142/13.7	.138/14.0	.136/14.0
5	7	.121/ 8.5	.140/ 8.5	.181/ 8.1	.227/ 7.9	.267/ 7.7	.296/ 7.5	.311/ 7.5	.311/ 7.5	.296/ 7.5	.269/ 7.5	.236/ 7.5	.209/ 7.5	.198/ 7.5
	9	.156/11.2	.173/ 9.5	.215/ 8.5	.265/ 8.3	.313/ 8.3	.352/ 8.1	.378/ 8.1	.389/ 8.1	.384/ [illegible]	.367/ 8.1	.344/ 8.1	.323/ 8.1	.315/ 8.3
	11	.163/12.1	.176/12.1	.208/11.6	.249/ 8.5	.292/ 8.5	.329/ 8.5	.356/ 8.3	.372/ 8.5	.376/ 8.5	.370/ 8.5	.359/ 8.5	.348/ 8.7	.344/ 8.7
	13	.156/12.8	.165/12.8	.189/12.6	.220/12.1	.254/ 8.7	.285/ 8.5	.310/ 8.5	.326/ 8.7	.334/ 8.7	.334/ 8.7	.329/ 9.0	.324/ 9.0	.322/ 9.0
	15	.143/13.7	.149/13.7	.167/13.4	.191/12.8	.217/11.6	.243/ 9.0	.264/ 8.7	.279/ 9.0	.287/ 9.0	.290/ 9.0	.289/ 9.2	.286/ 9.2	.285/ 9.2
	17	.128/14.6	.133/14.6	.146/14.3	.165/13.7	.186/12.8	.206/ 9.0	.224/ 9.0	.237/ 9.0	.245/ 9.2	.248/ 9.2	.249/ 9.5	.248/ 9.5	.248/ 9.5
	19	.113/15.3	.117/15.3	.127/15.0	.142/14.6	.159/13.7	.176/12.8	.190/ 9.2	.202/ 9.2	.209/ 9.2	.213/ 9.5	.214/ 9.5	.214/ 9.8	.213/ 9.8
	21	.099/16.1	.102/16.1	.110/16.1	.123/15.7	.136/15.0	.150/13.7	.163/ 9.2	.172/ 9.2	.179/ 9.2	.182/ 9.5	.184/ 9.8	.184/ 9.8	.184/ 9.8
10	7	.087/ 9.5	.112/ 7.7	.162/ 7.7	.214/ 7.5	.259/ 7.5	.291/ 7.5	.308/ 7.3	.309/ 7.3	.294/ 7.3	.265/ 7.3	.229/ 7.3	.198/ 7.1	.185/ 7.1
	9	.109/12.8	.131/ 9.5	.181/ 8.7	.240/ 7.9	.299/ 7.7	.350/ 7.7	.388/ 7.7	.410/ 7.7	.416/ 7.7	.407/ 7.7	.390/ 7.7	.373/ 7.7	.367/ 7.7
	11	.116/15.0	.132/15.0	.171/ 9.5	.223/ 8.3	.279/ 8.1	.332/ 8.1	.377/ 8.1	.410/ 8.1	.432/ 8.1	.441/ 8.1	.441/ 8.1	.439/ 8.1	.437/ 8.1
	13	.112/15.7	.124/15.3	.154/15.3	.195/ 9.5	.242/ 8.3	.289/ 8.1	.332/ 8.1	.367/ 8.1	.393/ 8.1	.409/ 8.3	.418/ 8.3	.421/ 8.3	.422/ 8.3
	15	.105/16.1	.113/16.1	.136/15.7	.168/15.3	.207/ 8.5	.246/ 8.3	.284/ 8.3	.316/ 8.3	.341/ 8.3	.359/ 8.3	.369/ 8.5	.375/ 8.5	.377/ 8.5
	17	.095/17.0	.102/17.0	.119/16.5	.145/15.7	.176/14.6	.209/ 8.5	.241/ 8.3	.269/ 8.3	.291/ 8.5	.308/ 8.5	.319/ 8.5	.325/ 8.5	.327/ 8.5
	19	.085/18.0	.090/18.0	.104/17.5	.125/16.5	.151/15.7	.178/ 8.5	.205/ 8.5	.229/ 8.5	.249/ 8.5	.263/ 8.5	.274/ 8.5	.279/ 8.7	.281/ 8.7
	21	.075/19.0	.079/19.0	.091/18.5	.108/17.5	.129/16.5	.152/ 8.5	.175/ 8.5	.195/ 8.5	.212/ 8.5	.226/ 8.5	.235/ 8.7	.240/ 8.7	.242/ 8.7
15	7	.074/ 8.1	.104/ 7.9	.158/ 7.5	.212/ 7.5	.259/ 7.5	.293/ 7.5	.310/ 7.3	.310/ 7.3	.293/ 7.3	.262/ 7.0	.222/ 7.0	.187/ 6.8	.172/ 6.8
	9	.083/11.6	.109/ 8.3	.164/ 8.1	.230/ 7.7	.297/ 7.5	.356/ 7.5	.402/ 7.5	.431/ 7.5	.442/ 7.5	.438/ 7.5	.422/ 7.5	.406/ 7.5	.399/ 7.5
	11	.085/17.5	.104/17.5	.150/ 8.3	.211/ 7.9	.278/ 7.7	.345/ 7.7	.404/ 7.7	.453/ 7.7	.487/ 7.7	.508/ 7.7	.517/ 7.7	.520/ 7.7	.520/ 7.7
	13	.082/20.3	.096/20.3	.132/20.3	.183/ 8.1	.242/ 7.9	.304/ 7.9	.363/ 7.9	.414/ 7.9	.456/ 7.9	.487/ 7.9	.507/ 7.9	.518/ 7.9	.522/ 7.9
	15	.078/20.3	.088/20.3	.116/20.3	.157/ 8.3	.206/ 7.9	.259/ 7.9	.312/ 7.9	.360/ 7.9	.401/ 7.9	.433/ 7.9	.455/ 7.9	.468/ 7.9	.472/ 8.1
	17	.072/20.3	.080/20.3	.101/20.3	.134/20.3	.175/ 8.1	.220/ 7.9	.265/ 7.9	.308/ 7.9	.344/ 7.9	.374/ 8.1	.395/ 8.1	.408/ 8.1	.412/ 8.1
	19	.065/20.9	.071/20.3	.089/20.3	.115/20.3	.149/ 8.1	.187/ 7.9	.225/ 7.9	.262/ 8.1	.294/ 8.1	.320/ 8.1	.339/ 8.1	.351/ 8.1	.355/ 8.1
	21	.058/21.7	.063/20.9	.077/20.9	.099/20.3	.128/ 8.1	.160/ 8.1	.192/ 8.1	.224/ 8.1	.251/ 8.1	.274/ 8.1	.291/ 8.1	.301/ 8.1	.305/ 8.1
20	7	.061/13.4	.090/ 8.3	.144/ 8.3	.199/ 8.3	.246/ 8.3	.281/ 7.0	.300/ 7.0	.301/ 7.0	.285/ 7.0	.255/ 6.8	.216/ 6.7	.178/ 6.7	.162/ 6.7
	9	.063/13.4	.090/ 9.0	.149/ 8.3	.221/ 7.5	.294/ 7.3	.360/ 7.3	.413/ 7.3	.447/ 7.3	.462/ 7.3	.458/ 7.3	.442/ 7.3	.424/ 7.1	.416/ 7.1
	11	.063/19.0	.084/19.0	.135/ 8.3	.204/ 7.5	.282/ 7.5	.361/ 7.5	.434/ 7.5	.494/ 7.5	.539/ 7.5	.568/ 7.5	.584/ 7.3	.589/ 7.3	.591/ 7.3
	13	.061/23.3	.077/23.3	.118/ 9.0	.177/ 7.5	.248/ 7.5	.323/ 7.5	.398/ 7.5	.465/ 7.5	.521/ 7.5	.564/ 7.5	.594/ 7.5	.611/ 7.5	.616/ 7.5
	15	.058/23.3	.070/23.3	.102/23.3	.151/ 8.1	.211/ 7.5	.278/ 7.5	.345/ 7.5	.409/ 7.5	.465/ 7.7	.510/ 7.7	.542/ 7.7	.562/ 7.7	.568/ 7.7
	17	.054/26.2	.063/26.2	.089/23.3	.129/ 8.1	.179/ 7.5	.236/ 7.5	.295/ 7.7	.351/ 7.7	.402/ 7.7	.443/ 7.7	.474/ 7.7	.493/ 7.7	.500/ 7.7
	19	.050/26.2	.057/26.2	.078/23.3	.110/19.0	.152/ 7.5	.200/ 7.7	.251/ 7.7	.300/ 7.7	.344/ 7.7	.381/ 7.7	.409/ 7.7	.426/ 7.9	.432/ 7.9
	21	.045/27.3	.050/27.3	.068/27.3	.095/19.0	.130/ 7.7	.171/ 7.7	.214/ 7.7	.256/ 7.7	.294/ 7.7	.327/ 7.7	.351/ 7.9	.366/ 7.9	.371/ 7.9

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 9 - SHIP B, ROOT MEAN SQUARE HEAVE RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B (MEMBRANE TANKS)

RMS HEAVE IN FEET/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.036/ 8.5	.042/ 8.5	.058/ 8.3	.075/ 8.3	.089/ 8.3	.099/ 8.3	.104/ 8.3	.102/ 8.3	.095/ 8.3	.084/ 8.3	.069/ 8.3	.055/ 8.3	.048/ 8.3
	9	.066/ 8.5	.076/ 9.0	.099/ 9.0	.124/ 9.0	.146/ 9.0	.162/ 9.0	.168/ 9.0	.165/ 9.0	.153/ 9.0	.134/ 8.7	.111/ 8.5	.088/ 8.5	.078/ 8.5
	11	.099/12.8	.108/12.6	.129/12.6	.154/11.6	.177/11.6	.192/11.2	.199/11.2	.195/11.2	.182/11.2	.162/11.6	.138/12.1	.117/12.6	.108/12.6
	13	.133/14.3	.139/14.3	.156/14.0	.177/13.7	.196/13.4	.209/13.4	.215/13.4	.211/13.4	.200/13.4	.183/14.0	.163/14.3	.146/14.3	.139/14.3
	15	.160/16.1	.165/16.1	.178/15.7	.194/15.7	.209/15.3	.220/15.3	.224/15.3	.222/15.3	.212/15.3	.198/15.7	.183/15.7	.170/16.1	.165/16.1
	17	.181/17.5	.185/17.5	.194/17.5	.206/17.5	.218/17.5	.227/17.5	.231/17.5	.228/17.5	.221/17.5	.210/17.5	.198/17.5	.189/17.5	.185/17.5
	19	.202/19.6	.205/19.6	.211/19.0	.220/19.0	.229/19.0	.236/19.0	.239/19.0	.237/19.0	.231/19.0	.223/19.0	.214/19.0	.208/19.0	.205/19.0
	21	.207/20.9	.209/20.9	.214/20.9	.222/20.9	.224/20.9	.235/20.9	.237/20.9	.235/20.9	.231/20.9	.224/20.9	.217/20.9	.211/20.9	.209/20.9
5	7	.037/ 9.2	.044/ 9.0	.060/ 8.3	.077/ 8.3	.091/ 8.3	.101/ 8.3	.104/ 8.3	.102/ 8.1	.094/ 8.1	.080/ 8.1	.064/ 8.1	.047/ 8.1	.039/ 8.1
	9	.062/10.5	.072/10.5	.097/10.1	.124/ 9.2	.147/ 9.0	.164/ 9.0	.172/ 9.0	.170/ 8.7	.159/ 8.7	.140/ 8.7	.116/ 8.7	.093/ 9.0	.083/ 9.0
	11	.094/14.3	.103/14.3	.125/13.7	.152/12.6	.176/11.6	.194/11.2	.203/10.8	.202/10.5	.191/10.5	.172/10.5	.150/10.8	.129/10.8	.121/11.2
	13	.127/16.1	.134/15.7	.152/15.3	.174/15.0	.195/14.3	.210/13.7	.218/13.4	.217/13.1	.208/12.8	.193/12.8	.174/12.8	.159/12.8	.152/12.8
	15	.155/17.5	.160/17.5	.173/17.0	.190/16.5	.207/16.1	.220/15.7	.227/15.3	.227/15.0	.219/14.6	.207/14.6	.193/14.6	.181/14.6	.177/14.6
	17	.177/19.0	.180/19.0	.190/19.0	.203/18.5	.216/18.0	.227/17.5	.232/17.0	.232/17.0	.227/16.5	.217/16.5	.207/16.5	.198/16.5	.195/16.5
	19	.198/20.9	.201/20.9	.208/20.9	.218/20.3	.228/20.3	.236/19.6	.240/19.0	.240/19.0	.236/18.5	.229/18.5	.221/18.5	.215/18.5	.212/18.5
	21	.203/22.4	.205/22.4	.211/21.7	.219/21.7	.228/20.9	.234/20.9	.238/20.3	.238/20.3	.235/20.3	.229/20.3	.223/20.3	.218/19.6	.216/19.6
10	7	.031/13.4	.040/ 8.7	.058/ 8.5	.076/ 8.5	.091/ 8.3	.101/ 8.3	.104/ 8.3	.101/ 8.1	.092/ 8.1	.078/ 7.9	.060/ 7.9	.043/ 7.9	.034/ 7.9
	9	.056/13.7	.067/13.7	.093/ 9.2	.122/ 9.0	.147/ 8.7	.165/ 8.7	.174/ 8.7	.174/ 8.5	.164/ 8.5	.147/ 8.5	.124/ 8.5	.103/ 8.5	.094/ 8.5
	11	.089/16.5	.098/16.5	.122/16.1	.150/13.4	.176/11.2	.196/10.5	.208/ 9.5	.210/ 9.5	.202/ 9.2	.187/ 9.2	.168/ 9.0	.151/ 9.0	.144/ 9.0
	13	.123/18.0	.130/18.0	.148/17.5	.171/17.0	.194/15.3	.212/14.0	.223/13.1	.226/12.6	.221/12.1	.209/11.6	.194/11.6	.181/11.2	.176/11.2
	15	.151/19.6	.156/19.6	.170/19.0	.188/18.5	.206/17.5	.221/16.5	.231/15.3	.234/14.6	.230/14.3	.221/14.0	.210/13.7	.200/13.4	.196/13.4
	17	.173/20.9	.177/20.9	.187/20.9	.201/20.3	.215/19.0	.227/18.5	.235/17.5	.238/16.5	.235/16.1	.228/15.7	.220/15.3	.213/15.3	.210/15.3
	19	.195/22.4	.198/22.4	.205/21.7	.216/20.9	.227/20.3	.236/19.6	.242/19.0	.244/18.5	.242/18.0	.237/17.5	.231/17.5	.226/17.0	.224/17.0
	21	.200/23.3	.202/23.3	.208/22.4	.217/21.7	.226/20.9	.234/20.3	.240/19.6	.242/19.0	.240/19.0	.236/19.0	.232/19.0	.227/19.0	.226/19.0
15	7	.029/17.5	.039/ 9.0	.059/ 8.5	.077/ 8.5	.092/ 8.3	.101/ 8.3	.104/ 8.1	.101/ 7.9	.091/ 7.9	.076/ 7.9	.057/ 7.7	.039/ 7.7	.030/ 7.5
	9	.053/19.6	.065/19.6	.091/10.1	.120/ 9.2	.146/ 8.7	.165/ 8.5	.175/ 8.5	.176/ 8.3	.168/ 8.3	.152/ 8.3	.131/ 8.1	.111/ 8.1	.103/ 8.1
	11	.086/20.3	.095/20.3	.119/20.3	.148/13.1	.175/10.1	.198/ 9.2	.213/ 9.0	.218/ 8.7	.214/ 8.7	.203/ 8.5	.188/ 8.5	.174/ 8.5	.169/ 8.5
	13	.120/20.9	.127/20.9	.145/20.9	.169/20.3	.193/15.7	.214/13.7	.229/12.8	.236/11.6	.235/10.1	.228/ 9.2	.218/ 9.0	.208/ 9.0	.205/ 8.7
	15	.148/21.7	.153/21.7	.167/21.7	.185/20.9	.205/20.3	.223/16.5	.236/15.3	.243/14.3	.243/13.7	.239/13.1	.231/12.6	.225/12.1	.222/12.1
	17	.170/23.3	.174/23.3	.184/23.3	.198/21.7	.214/20.9	.229/19.0	.239/17.5	.245/16.1	.246/15.3	.243/15.0	.238/14.6	.233/14.3	.231/14.3
	19	.192/24.2	.195/24.2	.203/23.3	.214/23.3	.226/21.7	.237/20.9	.245/18.5	.250/18.0	.251/17.5	.249/17.0	.245/16.1	.242/16.1	.240/16.1
	21	.197/26.2	.200/26.2	.206/26.2	.215/23.3	.225/23.3	.235/20.9	.242/19.0	.246/18.0	.247/18.0	.246/18.0	.243/18.0	.240/18.0	.239/18.0
20	7	.029/13.7	.040/ 9.2	.060/ 9.0	.078/ 8.5	.093/ 8.3	.101/ 8.1	.104/ 7.9	.100/ 7.9	.089/ 7.7	.074/ 7.7	.054/ 7.7	.036/ 7.3	.026/ 7.1
	9	.051/19.0	.063/19.0	.090/19.0	.119/ 9.0	.144/ 8.5	.164/ 8.3	.174/ 8.3	.176/ 8.1	.168/ 7.9	.152/ 7.9	.132/ 7.9	.113/ 7.7	.105/ 7.7
	11	.083/23.3	.093/23.3	.117/23.3	.146/23.3	.175/10.5	.199/ 9.0	.216/ 8.5	.224/ 8.3	.223/ 8.3	.215/ 8.3	.203/ 8.3	.192/ 8.1	.187/ 8.1
	13	.117/26.2	.124/26.2	.142/26.2	.167/23.3	.193/15.7	.216/14.3	.234/11.2	.245/ 8.7	.249/ 8.5	.246/ 8.5	.240/ 8.5	.234/ 8.3	.231/ 8.3
	15	.145/26.2	.150/26.2	.164/26.2	.184/26.2	.205/23.3	.225/16.1	.241/15.3	.252/13.7	.257/12.6	.257/11.2	.254/ 8.7	.251/ 8.7	.249/ 8.7
	17	.167/27.3	.171/27.3	.182/27.3	.197/27.3	.214/23.3	.230/19.0	.244/17.0	.253/16.1	.258/15.0	.259/14.0	.258/13.7	.256/13.1	.255/13.1
	19	.190/27.3	.193/27.3	.201/27.3	.212/27.3	.225/27.3	.238/20.3	.249/19.0	.256/17.0	.261/17.0	.262/16.1	.261/15.3	.260/15.0	.259/15.0
	21	.195/27.3	.197/27.3	.204/27.3	.214/27.3	.225/27.3	.236/20.3	.245/19.0	.252/17.0	.256/17.0	.257/17.0	.256/17.0	.256/17.0	.255/17.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 10 - SHIP B, ROOT MEAN SQUARE PITCH RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B (MEMBRANE TANKS)

RMS PITCH IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.025/ 7.7	.027/ 7.7	.030/ 7.7	.033/ 7.7	.035/ 7.7	.036/ 7.7	.036/ 7.9	.034/ 7.9	.031/ 7.9	.028/ 7.9	.024/ 7.7	.022/ 8.7	.021/ 9.0
	9	.044/10.1	.045/10.1	.047/10.1	.049/ 9.8	.051/ 9.0	.051/ 9.0	.051/ 9.0	.049/ 9.0	.047/ 9.2	.044/ 9.8	.042/10.1	.041/10.1	.041/10.1
	11	.056/11.2	.056/11.2	.056/11.2	.056/10.8	.055/10.5	.055/10.1	.054/10.1	.053/10.1	.053/10.8	.053/10.8	.053/11.2	.054/11.2	.054/11.2
	13	.060/12.1	.060/12.1	.058/12.1	.056/12.1	.054/11.6	.052/11.2	.051/11.2	.051/11.2	.052/11.6	.054/12.1	.056/12.1	.058/12.1	.059/12.1
	15	.059/13.4	.059/13.4	.057/13.4	.054/13.1	.051/12.8	.048/12.6	.047/12.1	.047/12.6	.049/12.8	.052/13.4	.055/13.4	.058/13.4	.058/13.4
	17	.056/14.3	.055/14.3	.053/14.3	.050/14.0	.046/14.0	.043/13.4	.042/13.4	.042/13.7	.045/14.0	.049/14.3	.052/14.3	.054/14.3	.055/14.3
	19	.051/15.3	.051/15.3	.048/15.3	.045/15.3	.041/15.0	.038/14.6	.037/14.6	.038/14.6	.041/15.0	.044/15.3	.048/15.3	.050/15.3	.051/15.3
	21	.046/16.1	.046/16.1	.043/16.1	.040/16.1	.037/16.1	.034/15.7	.033/15.3	.033/15.7	.036/16.1	.040/16.1	.043/16.1	.045/16.1	.046/16.1
5	7	.024/ 8.5	.026/ 8.5	.029/ 8.5	.033/ 8.3	.035/ 8.3	.036/ 8.1	.036/ 8.1	.034/ 8.1	.030/ 7.9	.026/ 7.9	.022/ 7.9	.020/ 8.1	.019/ 8.1
	9	.039/12.1	.040/12.1	.042/12.1	.045/11.6	.047/ 8.7	.049/ 8.7	.049/ 8.7	.049/ 8.7	.047/ 8.7	.046/ 8.7	.045/ 9.0	.044/ 9.0	.044/ 9.0
	11	.049/13.1	.050/13.1	.050/13.1	.051/12.8	.051/12.6	.052/11.2	.052/ 9.8	.053/ 9.5	.055/ 9.5	.056/ 9.5	.058/ 9.8	.059/ 9.8	.060/ 9.8
	13	.054/14.3	.054/14.0	.053/14.0	.052/13.7	.050/13.4	.050/12.8	.050/11.2	.052/10.5	.055/10.5	.058/10.5	.061/10.5	.064/10.8	.065/10.8
	15	.054/15.0	.054/15.0	.052/15.0	.050/15.0	.047/14.6	.046/13.7	.046/12.6	.048/11.6	.052/11.6	.056/11.6	.060/11.6	.063/11.6	.064/11.6
	17	.052/16.1	.051/16.1	.049/16.1	.046/15.7	.043/15.7	.041/15.0	.041/13.7	.043/12.8	.047/12.6	.052/12.6	.056/12.8	.059/12.8	.060/12.8
	19	.048/17.0	.047/17.0	.045/17.0	.042/16.5	.039/16.5	.037/15.7	.037/15.0	.039/14.0	.042/13.7	.047/14.0	.051/14.0	.053/14.0	.054/14.0
	21	.043/18.0	.043/18.0	.041/18.0	.038/18.0	.035/17.5	.033/17.0	.032/15.7	.034/15.0	.038/14.6	.042/14.6	.045/14.6	.048/14.6	.049/14.6
10	7	.020/12.8	.022/12.8	.027/ 9.8	.031/ 7.9	.034/ 7.9	.035/ 7.9	.034/ 7.9	.032/ 7.9	.028/ 7.7	.024/ 7.5	.019/ 7.3	.017/ 7.3	.016/ 7.3
	9	.033/15.0	.035/15.0	.038/15.0	.041/13.1	.044/ 9.8	.046/ 8.5	.047/ 8.3	.047/ 8.3	.046/ 8.1	.045/ 8.3	.044/ 8.3	.043/ 8.3	.043/ 8.3
	11	.044/15.7	.045/15.7	.046/15.7	.046/15.3	.047/15.0	.049/14.3	.051/ 9.0	.053/ 9.0	.055/ 9.0	.058/ 9.0	.060/ 9.0	.062/ 9.0	.062/ 9.0
	13	.050/16.5	.049/16.5	.049/16.5	.048/16.1	.047/16.1	.047/15.3	.049/ 9.8	.052/ 9.8	.056/ 9.5	.061/ 9.5	.065/ 9.5	.068/ 9.5	.069/ 9.5
	15	.050/17.5	.050/17.5	.048/17.0	.046/17.0	.044/16.5	.044/16.1	.045/14.0	.049/10.5	.053/10.5	.059/10.5	.063/10.5	.066/10.5	.067/10.5
	17	.049/18.5	.048/18.5	.046/18.0	.044/18.0	.041/17.5	.040/17.0	.041/15.3	.044/11.6	.049/11.2	.054/11.2	.059/11.2	.062/11.2	.063/11.2
	19	.045/19.0	.045/19.0	.043/19.0	.040/19.0	.037/18.5	.036/17.5	.036/16.1	.039/13.4	.044/12.1	.049/12.1	.053/12.1	.056/12.1	.057/12.1
	21	.041/19.6	.040/19.6	.039/19.6	.036/19.6	.033/19.0	.032/18.5	.032/17.0	.035/14.6	.039/13.7	.044/13.4	.048/13.4	.050/13.4	.051/13.4
15	7	.018/14.3	.020/14.3	.025/ 8.5	.029/ 8.5	.032/ 8.3	.034/ 8.3	.033/ 8.3	.031/ 8.3	.027/ 7.7	.022/ 7.3	.017/ 7.1	.014/ 7.0	.013/ 7.0
	9	.030/17.5	.032/17.5	.035/17.5	.038/17.5	.041/17.5	.043/ 8.5	.045/ 8.1	.045/ 7.9	.044/ 7.7	.043/ 7.7	.041/ 7.7	.041/ 7.7	.041/ 7.7
	11	.041/20.3	.041/20.3	.042/20.3	.043/20.3	.045/17.5	.047/17.5	.049/ 8.5	.052/ 8.3	.055/ 8.3	.057/ 8.3	.060/ 8.3	.061/ 8.3	.062/ 8.3
	13	.046/20.3	.046/20.3	.046/20.3	.045/20.3	.045/20.3	.046/18.0	.048/ 9.0	.052/ 9.0	.057/ 9.0	.062/ 9.0	.066/ 9.0	.069/ 9.0	.070/ 9.0
	15	.048/20.3	.047/20.3	.046/20.3	.044/20.3	.043/20.3	.043/19.6	.045/18.0	.049/ 9.5	.055/ 9.5	.060/ 9.5	.065/ 9.5	.068/ 9.5	.070/ 9.5
	17	.046/20.9	.046/20.9	.044/20.3	.042/20.3	.039/20.3	.039/20.3	.040/18.0	.044/10.1	.050/10.1	.056/10.1	.061/10.1	.064/10.1	.065/10.1
	19	.043/20.9	.043/20.9	.041/20.9	.038/20.9	.036/20.9	.035/20.3	.036/18.0	.040/12.1	.045/11.2	.050/10.8	.055/10.8	.058/10.8	.060/10.8
	21	.039/21.7	.039/21.7	.037/21.7	.035/21.7	.032/21.7	.031/20.9	.032/18.5	.035/13.1	.040/12.1	.045/11.6	.049/11.6	.052/11.6	.053/11.6
20	7	.016/13.4	.018/13.4	.023/13.4	.027/13.4	.030/13.4	.031/13.4	.031/13.4	.029/ 9.0	.025/ 9.0	.020/ 7.0	.015/ 6.8	.012/ 6.7	.011/ 6.7
	9	.028/23.3	.029/23.3	.032/19.0	.036/19.0	.039/19.0	.041/19.0	.043/13.7	.043/ 7.3	.042/ 7.3	.040/ 7.3	.039/ 7.3	.038/ 7.3	.038/ 7.3
	11	.039/23.3	.039/23.3	.040/23.3	.041/23.3	.043/19.0	.045/19.0	.048/19.0	.051/ 7.7	.054/ 7.7	.057/ 7.7	.059/ 7.7	.060/ 7.7	.061/ 7.7
	13	.044/23.3	.044/23.3	.044/23.3	.043/23.3	.043/23.3	.045/23.3	.048/19.0	.052/ 8.3	.057/ 8.1	.062/ 8.1	.067/ 8.1	.070/ 8.1	.071/ 8.1
	15	.046/26.2	.045/26.2	.044/26.2	.042/26.2	.041/23.3	.042/23.3	.045/23.3	.049/ 9.0	.055/ 8.7	.061/ 8.7	.066/ 8.7	.070/ 8.7	.071/ 8.7
	17	.045/26.2	.044/26.2	.042/26.2	.040/26.2	.038/23.3	.038/23.3	.040/23.3	.045/ 9.5	.051/ 9.5	.057/ 9.5	.062/ 9.5	.066/ 9.5	.067/ 9.5
	19	.042/26.2	.041/26.2	.040/26.2	.037/26.2	.035/26.2	.034/23.3	.036/23.3	.040/10.1	.046/10.1	.051/10.1	.056/10.1	.060/10.1	.061/10.1
	21	.038/27.3	.038/27.3	.036/27.3	.034/27.3	.031/26.2	.030/23.3	.032/23.3	.035/10.8	.041/10.8	.046/10.8	.050/10.8	.053/10.8	.055/10.8

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 11 - SHIP B, GM = 1.5 FT, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 1.5FT (MEMBRANE TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.009/ 7.7	.010/ 7.7	.011/ 7.7	.012/ 7.5	.013/ 7.5	.014/ 7.3	.014/ 7.1	.014/ 7.1	.013/ 7.1	.011/ 7.3	.010/ 7.5	.009/ 7.5	.008/ 7.5
	9	.011/ 7.9	.011/ 8.1	.013/ 8.3	.014/ 8.3	.016/ 8.5	.016/ 8.5	.016/ 8.7	.016/ 8.5	.015/ 8.5	.013/ 8.3	.011/ 7.9	.010/ 7.7	.009/ 7.7
	11	.011/ 8.5	.011/ 8.5	.013/10.8	.014/10.5	.016/10.5	.016/10.5	.016/10.5	.016/10.5	.015/10.5	.013/10.8	.011/11.2	.010/11.6	.009/11.6
	13	.011/13.1	.011/12.8	.012/12.6	.014/11.6	.015/11.6	.015/11.6	.016/11.2	.015/11.6	.014/11.6	.013/12.1	.011/13.4	.010/13.7	.009/13.7
	15	.010/14.0	.011/14.0	.012/13.7	.013/13.4	.014/13.4	.014/13.4	.014/13.4	.014/13.7	.013/14.0	.012/14.6	.011/15.0	.010/15.0	.010/15.0
	17	.010/16.1	.010/16.1	.011/15.7	.012/15.3	.013/15.3	.013/15.3	.013/15.3	.013/15.3	.012/15.7	.012/16.1	.011/16.1	.010/16.1	.010/16.5
	19	.010/19.0	.010/19.0	.011/21.7	.011/21.7	.012/21.7	.012/21.7	.012/16.5	.012/16.5	.012/16.5	.011/17.0	.010/17.5	.009/17.5	.009/17.5
	21	.010/21.7	.010/21.7	.011/21.7	.011/21.7	.012/21.7	.012/21.7	.012/21.7	.012/21.7	.012/21.7	.011/21.7	.011/21.7	.010/21.7	.010/21.7
5	7	.014/ 9.2	.014/ 9.2	.014/ 8.3	.015/ 8.3	.016/ 8.3	.016/ 8.3	.015/ 8.3	.014/ 7.9	.012/ 7.1	.010/ 7.0	.008/ 6.5	.007/ 6.4	.006/ 6.4
	9	.015/ 9.5	.015/ 9.5	.016/ 9.5	.017/ 9.5	.017/ 9.5	.018/ 9.2	.017/ 9.0	.016/ 9.0	.014/ 9.0	.012/ 9.0	.010/ 9.0	.008/ 6.7	.007/ 6.5
	11	.014/ 9.8	.014/ 9.8	.015/ 9.8	.016/ 9.8	.017/ 9.8	.017/10.1	.017/10.1	.016/10.1	.014/10.1	.012/10.5	.010/10.5	.008/10.8	.008/10.8
	13	.013/15.0	.014/14.6	.014/14.0	.015/13.7	.016/13.4	.016/11.6	.016/11.2	.015/11.2	.014/11.2	.012/11.2	.010/11.6	.009/11.6	.008/12.1
	15	.013/16.1	.013/16.1	.014/16.1	.015/15.7	.015/15.3	.015/14.0	.015/13.7	.014/13.7	.013/13.7	.011/14.0	.010/14.0	.009/14.3	.008/14.3
	17	.013/18.5	.013/18.5	.013/18.5	.014/18.0	.014/17.0	.014/16.1	.014/15.7	.013/15.7	.012/15.3	.011/15.3	.010/15.7	.009/15.7	.009/15.7
	19	.014/22.4	.014/22.4	.014/22.4	.015/22.4	.015/22.4	.014/22.4	.014/18.0	.013/17.0	.012/16.5	.010/16.5	.009/17.0	.009/17.0	.008/17.0
	21	.014/22.4	.014/22.4	.014/22.4	.014/22.4	.014/22.4	.014/22.4	.013/22.4	.012/20.3	.011/18.0	.010/18.0	.009/18.0	.008/18.0	.008/18.0
10	7	.022/12.8	.022/12.8	.022/12.8	.022/11.6	.021/11.6	.020/10.5	.017/10.5	.015/10.5	.012/ 8.3	.009/ 8.1	.007/ 6.8	.005/ 5.7	.004/ 5.7
	9	.023/12.8	.023/12.8	.023/12.8	.022/12.1	.022/12.1	.021/10.5	.019/10.5	.016/10.5	.014/ 8.7	.011/ 8.7	.009/ 8.5	.007/ 8.5	.006/ 8.7
	11	.020/12.8	.020/12.8	.021/12.8	.021/12.8	.021/12.1	.020/12.1	.019/10.5	.016/10.5	.014/10.5	.012/10.1	.009/ 9.8	.008/10.1	.007/10.1
	13	.019/12.8	.019/12.8	.019/12.8	.020/12.8	.020/12.8	.019/12.1	.018/12.1	.016/10.8	.014/10.8	.012/10.8	.010/10.8	.008/11.2	.007/11.2
	15	.019/18.5	.019/18.5	.019/18.5	.019/18.0	.019/18.0	.018/17.5	.017/16.1	.015/14.6	.013/13.7	.011/11.6	.010/13.7	.008/14.0	.008/14.0
	17	.019/21.7	.019/21.7	.019/20.9	.019/20.9	.019/20.3	.018/19.6	.016/18.5	.015/16.1	.013/15.3	.011/15.3	.010/15.3	.009/15.3	.008/15.3
	19	.022/23.3	.022/23.3	.022/23.3	.021/23.3	.020/23.3	.019/22.4	.017/22.4	.015/22.4	.012/17.0	.011/16.5	.009/16.5	.008/16.5	.008/16.5
	21	.022/24.2	.022/24.2	.022/24.2	.022/23.3	.021/23.3	.019/23.3	.017/23.3	.014/22.4	.012/18.0	.010/17.5	.009/17.5	.008/17.5	.008/17.5
15	7	.416/29.9	.403/29.9	.365/29.9	.305/29.9	.230/29.9	.154/29.9	.081/29.9	.020/14.3	.013/10.1	.009/10.1	.007/ 6.7	.005/ 6.7	.004/ 6.4
	9	.310/29.9	.300/29.9	.272/29.9	.228/29.9	.172/29.9	.115/29.9	.062/29.9	.021/14.3	.015/10.1	.011/10.1	.008/ 8.3	.006/ 8.1	.005/ 8.1
	11	.222/29.9	.215/29.9	.195/29.9	.163/29.9	.124/29.9	.083/29.9	.046/29.9	.020/14.3	.015/10.1	.012/10.1	.009/ 9.8	.007/ 9.5	.006/ 9.5
	13	.164/29.9	.159/29.9	.144/29.9	.121/29.9	.092/29.9	.063/29.9	.035/29.9	.019/17.5	.015/10.1	.012/10.5	.010/10.5	.008/10.5	.007/10.8
	15	.126/29.9	.122/29.9	.110/29.9	.093/29.9	.071/29.9	.049/29.9	.029/29.9	.018/17.5	.014/14.3	.012/11.6	.010/11.6	.008/11.6	.008/11.6
	17	.100/29.9	.097/29.9	.088/29.9	.075/29.9	.058/29.9	.040/29.9	.025/26.2	.018/22.4	.014/16.1	.011/15.3	.010/15.0	.008/15.0	.008/15.0
	19	.083/27.3	.081/27.3	.074/27.3	.063/27.3	.050/27.3	.036/26.2	.023/26.2	.019/23.3	.014/23.3	.011/16.5	.009/16.1	.008/16.1	.008/16.1
	21	.071/27.3	.069/27.3	.063/27.3	.054/27.3	.044/27.3	.033/26.2	.022/26.2	.019/24.2	.014/23.3	.011/18.0	.009/17.5	.008/17.5	.008/17.5
20	7	.324/29.9	.317/29.9	.298/29.9	.269/29.9	.236/29.9	.195/29.9	.141/29.9	.149/29.9	.043/27.3	.010/13.4	.006/ 7.0	.004/ 6.4	.003/ 6.3
	9	.341/29.9	.334/29.9	.312/29.9	.281/29.9	.245/29.9	.201/29.9	.144/29.9	.148/29.9	.035/27.3	.012/13.4	.008/ 7.7	.006/ 7.7	.005/ 7.5
	11	.273/29.9	.268/29.9	.250/29.9	.225/29.9	.196/29.9	.161/29.9	.115/29.9	.118/29.9	.028/26.2	.012/13.4	.009/ 9.5	.007/ 9.2	.006/ 9.2
	13	.211/29.9	.206/29.9	.193/29.9	.174/29.9	.151/29.9	.124/29.9	.089/29.9	.091/29.9	.023/20.3	.012/13.4	.009/10.5	.008/10.1	.007/10.1
	15	.165/29.9	.162/29.9	.151/29.9	.136/29.9	.119/29.9	.098/29.9	.070/29.9	.073/29.9	.021/20.9	.012/13.4	.010/11.2	.008/11.2	.008/11.2
	17	.133/29.9	.131/29.9	.122/29.9	.110/29.9	.096/29.9	.080/29.9	.057/29.9	.060/29.9	.020/23.3	.012/13.4	.010/14.6	.008/14.6	.008/14.6
	19	.111/29.9	.109/29.9	.103/29.9	.093/29.9	.081/29.9	.068/29.9	.049/29.9	.053/29.9	.020/25.1	.012/16.5	.009/16.1	.008/16.1	.008/16.1
	21	.096/29.9	.094/29.9	.088/29.9	.080/29.9	.071/29.9	.059/29.9	.043/29.9	.048/29.9	.020/27.3	.012/17.0	.009/17.0	.008/17.0	.008/17.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 12 - SHIP B, GM = 1.5 FT, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM =1.5FT (MEMBRANE TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.018/ 7.7	.019/ 7.7	.021/ 7.7	.023/ 7.7	.026/ 7.7	.028/ 7.7	.029/ 7.7	.030/ 7.7	.029/ 7.7	.028/ 7.7	.026/ 7.7	.024/ 7.7	.024/ 7.7
	9	.031/10.8	.031/10.8	.033/10.8	.035/10.5	.037/10.1	.039/ 9.8	.040/ 9.8	.040/ 9.8	.040/10.1	.039/10.5	.038/10.5	.037/10.8	.037/10.8
	11	.046/12.1	.046/12.1	.046/12.1	.045/11.6	.045/11.6	.045/11.2	.046/11.2	.047/11.2	.048/11.2	.049/11.6	.050/11.6	.050/11.6	.051/11.6
	13	.056/13.4	.055/13.4	.054/13.1	.052/13.1	.050/12.8	.048/12.6	.047/12.6	.048/12.6	.051/12.6	.054/12.8	.056/12.8	.058/12.8	.059/12.8
	15	.060/14.3	.059/14.3	.057/14.3	.054/14.3	.050/14.0	.047/13.7	.046/13.4	.047/13.4	.050/13.7	.054/14.0	.058/14.0	.061/14.0	.061/14.0
	17	.060/15.3	.059/15.3	.056/15.3	.053/15.3	.048/15.0	.045/15.0	.043/14.6	.045/14.6	.048/15.0	.052/15.0	.056/15.0	.059/15.0	.060/15.0
	19	.057/16.5	.056/16.5	.054/16.5	.050/16.1	.045/16.1	.041/16.1	.040/15.7	.041/15.7	.044/16.1	.049/16.1	.053/16.1	.056/16.1	.057/16.1
	21	.053/17.5	.052/17.5	.049/17.5	.045/17.5	.041/17.5	.037/17.0	.036/17.0	.037/17.0	.040/17.0	.044/17.5	.048/17.5	.051/17.5	.052/17.5
5	7	.018/ 9.8	.018/ 9.5	.020/ 9.5	.023/ 9.5	.026/ 8.3	.028/ 8.1	.029/ 7.5	.029/ 7.5	.029/ 7.3	.027/ 6.4	.025/ 6.4	.024/ 6.4	.023/ 6.4
	9	.031/12.8	.031/12.6	.033/12.6	.035/12.1	.037/10.5	.039/ 9.5	.040/ 9.5	.040/ 9.2	.040/ 9.2	.039/ 9.2	.038/ 9.2	.037/ 9.5	.037/ 9.5
	11	.046/13.7	.045/13.7	.045/13.7	.045/13.4	.045/13.1	.045/12.6	.046/11.2	.047/10.5	.048/10.5	.049/10.5	.050/10.5	.051/10.5	.051/10.5
	13	.055/15.0	.055/15.0	.054/14.6	.051/14.6	.049/14.3	.048/13.7	.047/12.8	.049/12.1	.051/11.6	.054/11.6	.057/11.6	.059/11.6	.059/11.6
	15	.060/16.1	.059/15.7	.057/15.7	.053/15.7	.050/15.3	.047/15.0	.046/14.0	.047/13.1	.051/12.8	.055/12.6	.058/12.8	.061/12.8	.062/12.8
	17	.060/17.0	.059/17.0	.056/17.0	.052/16.5	.048/16.5	.045/16.1	.043/15.0	.045/14.3	.048/14.0	.053/14.0	.057/14.0	.060/14.0	.061/14.0
	19	.057/18.0	.056/18.0	.053/18.0	.049/18.0	.045/17.5	.041/17.0	.040/16.1	.041/15.3	.044/15.0	.049/15.0	.053/15.0	.056/15.0	.057/15.0
	21	.052/19.0	.052/19.0	.049/19.0	.045/19.0	.041/18.5	.037/18.0	.036/17.5	.037/16.5	.040/16.1	.045/16.1	.049/16.1	.051/16.1	.052/16.1
10	7	.017/13.4	.018/13.4	.020/13.4	.023/13.4	.025/10.5	.027/ 8.1	.029/ 7.9	.029/ 7.3	.028/ 7.1	.026/ 7.0	.025/ 7.0	.023/ 5.2	.023/ 5.2
	9	.030/13.4	.031/13.4	.032/13.4	.034/13.4	.037/13.4	.038/12.1	.040/ 8.5	.040/ 8.3	.040/ 8.3	.039/ 8.3	.038/ 8.3	.037/ 8.5	.037/ 8.5
	11	.045/16.1	.045/16.1	.045/16.1	.045/16.1	.045/15.7	.045/15.0	.046/10.5	.047/ 9.5	.048/ 9.5	.049/ 9.5	.050/ 9.5	.051/ 9.5	.051/ 9.5
	13	.055/17.0	.054/17.0	.053/17.0	.051/17.0	.049/16.5	.047/16.1	.047/14.6	.049/11.2	.051/10.8	.054/10.5	.057/10.5	.059/10.5	.060/10.5
	15	.059/18.0	.058/18.0	.056/18.0	.053/17.5	.049/17.5	.047/17.0	.046/15.7	.047/12.8	.051/12.1	.055/11.6	.059/11.6	.061/11.6	.062/11.6
	17	.059/19.0	.058/19.0	.056/19.0	.052/18.5	.048/18.5	.044/17.5	.043/16.5	.045/14.0	.048/13.1	.053/12.8	.057/12.8	.060/12.8	.061/12.8
	19	.056/19.6	.055/19.6	.053/19.6	.049/19.6	.045/19.0	.041/18.5	.040/17.5	.041/15.3	.045/14.3	.049/14.0	.053/14.0	.056/14.0	.057/14.0
	21	.052/20.9	.051/20.9	.049/20.9	.045/20.3	.041/20.3	.037/19.6	.036/18.5	.037/16.5	.040/15.3	.045/15.0	.049/15.0	.052/15.0	.053/15.0
15	7	.017/17.5	.018/17.5	.020/17.5	.023/17.5	.025/17.5	.027/10.1	.028/10.1	.028/ 6.4	.027/ 6.4	.026/ 6.5	.024/ 6.5	.022/ 4.8	.022/ 4.8
	9	.030/19.6	.030/19.6	.032/19.6	.034/19.6	.036/17.5	.038/12.6	.039/12.6	.040/ 7.7	.040/ 7.7	.039/ 7.7	.038/ 7.7	.037/ 7.7	.037/ 7.7
	11	.045/20.3	.045/20.3	.044/20.3	.044/20.3	.044/20.3	.045/18.0	.046/15.7	.047/ 9.0	.048/ 8.7	.049/ 8.7	.050/ 8.7	.051/ 8.7	.052/ 8.7
	13	.054/20.3	.054/20.3	.053/20.3	.051/20.3	.049/20.3	.047/19.6	.047/18.0	.049/10.1	.051/ 9.8	.054/ 9.8	.057/ 9.8	.059/ 9.8	.060/ 9.8
	15	.059/20.9	.058/20.9	.056/20.9	.052/20.3	.049/20.3	.047/20.3	.046/18.5	.047/11.6	.051/10.8	.055/10.8	.059/10.8	.062/10.8	.063/10.8
	17	.059/21.7	.058/21.7	.055/20.9	.051/20.9	.047/20.9	.044/20.3	.043/19.6	.045/13.1	.048/12.1	.053/12.1	.057/12.1	.060/12.1	.061/12.1
	19	.056/21.7	.055/21.7	.052/21.7	.049/21.7	.044/21.7	.041/20.9	.040/19.6	.041/15.7	.045/13.4	.049/13.1	.054/13.1	.057/13.1	.058/12.8
	21	.052/22.4	.051/22.4	.048/22.4	.045/22.4	.040/22.4	.037/21.7	.036/18.5	.037/16.5	.040/14.6	.045/14.3	.049/14.0	.052/14.0	.053/14.0
20	7	.017/13.4	.018/13.4	.020/13.4	.022/13.4	.025/13.4	.027/13.4	.027/13.4	.027/13.4	.026/ 6.3	.025/ 6.3	.023/ 6.3	.021/ 4.2	.021/ 4.2
	9	.030/23.3	.030/19.0	.032/19.0	.034/19.0	.036/19.0	.038/19.0	.039/19.0	.039/ 7.0	.039/ 7.0	.038/ 7.0	.037/ 7.0	.036/ 7.0	.036/ 7.0
	11	.044/23.3	.044/23.3	.044/23.3	.044/23.3	.044/19.0	.044/19.0	.045/19.0	.046/ 8.3	.048/ 8.1	.049/ 8.1	.050/ 8.1	.051/ 7.9	.052/ 7.9
	13	.054/23.3	.053/23.3	.052/23.3	.050/23.3	.048/23.3	.047/23.3	.047/19.0	.048/ 9.5	.051/ 9.2	.054/ 9.0	.057/ 9.0	.059/ 9.0	.060/ 9.0
	15	.058/26.2	.057/26.2	.055/26.2	.052/26.2	.049/23.3	.046/23.3	.046/23.3	.047/10.5	.051/10.1	.055/10.1	.059/10.1	.062/10.1	.063/10.1
	17	.058/26.2	.057/26.2	.055/26.2	.051/26.2	.047/26.2	.044/23.3	.043/23.3	.045/11.6	.048/11.2	.053/11.2	.057/11.2	.060/11.2	.061/11.2
	19	.056/27.3	.055/27.3	.052/27.3	.048/26.2	.044/26.2	.041/23.3	.039/23.3	.041/14.6	.045/12.6	.049/12.1	.054/12.1	.057/12.1	.058/12.1
	21	.051/27.3	.050/27.3	.048/27.3	.044/27.3	.040/26.2	.037/23.3	.036/23.3	.037/15.3	.041/14.3	.045/13.4	.049/13.4	.052/13.4	.053/13.4

NOTE: V IS SHIP SPEED IN KNOTS AND T_D IS MODAL WAVE PERIOD IN SECONDS.

TABLE 13 - SHIP B, GM = 1.5 FT, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM =1.5FT (MEMBRANE TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.047/ 8.3	.061/ 7.9	.092/ 7.7	.125/ 7.3	.153/ 7.1	.173/ 7.0	.183/ 7.0	.181/ 7.0	.169/ 7.0	.146/ 7.0	.116/ 7.0	.085/ 7.0	.069/ 7.1
	9	.071/ 9.5	.083/ 9.5	.111/ 9.2	.143/ 9.0	.170/ 8.7	.189/ 8.7	.197/ 8.5	.194/ 8.5	.180/ 8.5	.157/ 8.7	.127/ 9.0	.097/ 9.2	.083/ 9.5
	11	.080/10.5	.090/10.5	.114/10.1	.141/10.1	.165/ 9.8	.181/ 9.8	.188/ 9.8	.184/ 9.8	.171/ 9.8	.150/ 9.8	.124/10.1	.099/10.5	.088/10.5
	13	.080/11.6	.088/11.2	.108/11.2	.130/10.8	.150/10.8	.164/10.8	.169/10.8	.166/10.8	.155/10.8	.136/10.8	.114/11.2	.094/11.2	.085/11.6
	15	.075/12.6	.081/12.6	.098/12.1	.117/12.1	.134/12.1	.145/12.1	.150/12.1	.147/12.1	.137/12.1	.121/12.1	.103/12.1	.086/12.6	.078/12.6
	17	.068/13.4	.073/13.4	.087/13.4	.104/13.4	.118/13.4	.128/13.4	.132/13.4	.129/13.4	.121/13.4	.107/13.7	.091/13.7	.077/14.0	.071/14.0
	19	.061/14.0	.065/14.0	.077/14.0	.091/14.0	.104/14.3	.112/14.6	.116/14.6	.113/14.6	.106/15.0	.094/15.0	.081/15.0	.068/15.0	.063/15.0
	21	.054/15.3	.058/15.3	.068/15.3	.080/15.7	.091/15.7	.098/15.7	.101/15.7	.099/15.7	.093/15.7	.083/15.7	.071/15.7	.060/15.7	.056/15.7
5	7	.046/ 8.7	.059/ 8.5	.090/ 7.5	.124/ 7.3	.154/ 7.3	.175/ 7.1	.186/ 7.0	.186/ 7.0	.174/ 6.8	.152/ 6.8	.123/ 6.8	.091/ 6.8	.075/ 7.0
	9	.067/10.8	.079/10.5	.107/ 9.8	.140/ 9.2	.169/ 9.0	.189/ 8.7	.200/ 8.5	.198/ 8.3	.186/ 8.3	.163/ 8.3	.134/ 8.3	.104/ 8.3	.090/ 8.5
	11	.075/12.1	.085/11.6	.109/11.2	.137/10.8	.162/10.5	.180/10.1	.189/ 9.8	.187/ 9.5	.176/ 9.5	.156/ 9.2	.130/ 9.5	.105/ 9.5	.094/ 9.5
	13	.074/12.8	.082/12.6	.102/12.1	.126/12.1	.147/11.6	.163/11.2	.170/10.8	.169/10.8	.159/10.5	.141/10.5	.119/10.5	.099/10.5	.090/10.5
	15	.069/13.7	.076/13.4	.093/13.1	.113/13.1	.131/12.6	.144/12.6	.150/12.1	.149/11.6	.140/11.6	.126/11.2	.107/11.2	.091/11.2	.083/11.2
	17	.063/14.6	.069/14.3	.083/14.0	.100/13.7	.115/13.7	.127/13.4	.132/13.4	.131/13.4	.124/13.4	.111/13.1	.095/12.8	.081/12.6	.075/12.6
	19	.056/15.7	.061/15.3	.073/15.3	.088/15.3	.101/15.0	.111/15.0	.116/14.6	.115/14.6	.108/14.3	.097/14.3	.084/14.3	.072/14.0	.067/14.0
	21	.050/16.1	.054/16.1	.064/16.1	.077/16.1	.089/16.1	.097/15.7	.101/15.7	.100/15.7	.095/15.3	.085/15.3	.074/15.3	.064/15.0	.059/15.0
10	7	.041/ 9.8	.056/ 9.5	.087/ 7.9	.122/ 7.7	.153/ 7.3	.175/ 6.7	.187/ 6.7	.188/ 6.4	.177/ 6.4	.156/ 6.4	.126/ 6.3	.095/ 6.4	.078/ 6.4
	9	.061/12.1	.074/11.6	.103/10.5	.136/ 9.8	.166/ 8.7	.189/ 8.5	.201/ 8.1	.201/ 7.9	.190/ 7.9	.168/ 7.7	.139/ 7.5	.110/ 7.5	.095/ 7.5
	11	.069/13.7	.079/13.4	.103/12.6	.132/11.6	.159/10.5	.179/10.1	.189/ 9.8	.190/ 9.2	.180/ 9.0	.160/ 9.0	.135/ 8.7	.111/ 8.7	.100/ 8.7
	13	.068/14.6	.076/14.3	.096/13.7	.121/13.1	.144/12.1	.161/11.6	.170/10.8	.171/10.5	.162/10.1	.146/ 9.8	.124/ 9.8	.104/ 9.5	.095/ 9.5
	15	.063/15.3	.070/15.3	.087/15.0	.108/14.0	.127/13.4	.142/13.1	.150/12.6	.151/11.6	.143/11.2	.130/10.8	.112/10.8	.095/10.5	.088/10.5
	17	.057/16.1	.063/15.7	.078/15.7	.096/15.3	.112/14.6	.125/14.0	.132/13.7	.132/13.4	.126/12.8	.114/12.1	.099/11.6	.085/11.6	.079/11.6
	19	.051/16.5	.056/16.5	.069/16.1	.084/15.7	.099/15.7	.110/15.3	.116/15.0	.116/14.6	.111/14.0	.100/14.0	.087/13.7	.076/13.4	.070/13.4
	21	.046/17.5	.050/17.0	.061/17.0	.074/16.5	.086/16.5	.096/16.1	.101/15.7	.101/15.7	.097/15.3	.088/15.0	.077/14.6	.067/14.6	.062/14.6
15	7	.038/14.3	.052/14.3	.084/ 8.5	.120/ 8.5	.152/ 6.3	.175/ 6.3	.188/ 6.3	.190/ 6.3	.179/ 6.3	.158/ 5.7	.129/ 5.7	.097/ 5.7	.080/ 5.7
	9	.056/14.6	.068/14.6	.097/11.6	.132/ 9.2	.164/ 8.7	.188/ 8.5	.201/ 8.3	.203/ 7.3	.193/ 7.1	.172/ 7.1	.143/ 7.0	.114/ 7.0	.100/ 7.0
	11	.062/17.5	.072/17.5	.097/14.6	.127/12.1	.155/11.6	.177/ 9.2	.190/ 9.2	.192/ 9.0	.183/ 8.7	.165/ 8.5	.140/ 8.3	.116/ 8.1	.104/ 7.9
	13	.061/17.5	.069/17.5	.090/15.0	.116/14.6	.140/12.6	.159/12.1	.170/11.2	.172/10.1	.165/ 9.5	.150/ 9.2	.129/ 9.2	.109/ 9.0	.100/ 9.0
	15	.057/17.5	.064/17.5	.081/17.5	.103/15.0	.124/15.0	.140/12.8	.150/12.6	.152/11.6	.146/11.2	.133/10.5	.116/10.1	.099/ 9.8	.092/ 9.8
	17	.052/17.5	.058/17.5	.073/17.5	.091/17.5	.109/15.3	.123/15.0	.132/14.3	.134/13.1	.128/12.6	.117/11.6	.103/11.2	.089/10.8	.083/10.8
	19	.046/19.6	.051/19.6	.064/17.5	.081/17.5	.096/17.5	.108/15.7	.115/15.3	.117/14.6	.113/13.7	.103/13.4	.090/13.1	.079/12.1	.073/12.1
	21	.041/19.6	.046/19.6	.057/19.6	.071/17.5	.084/17.5	.094/17.5	.101/16.1	.102/15.3	.098/15.3	.090/14.6	.079/14.3	.069/14.0	.065/14.0
20	7	.034/13.4	.049/13.4	.081/13.4	.118/13.4	.150/13.4	.174/ 5.7	.188/ 5.7	.190/ 5.7	.180/ 5.7	.159/ 5.7	.130/ 5.7	.097/ 5.7	.080/ 5.2
	9	.049/19.0	.062/19.0	.092/13.4	.128/13.4	.161/13.4	.186/ 7.0	.201/ 7.0	.204/ 7.0	.195/ 6.8	.175/ 6.7	.147/ 6.7	.117/ 6.4	.103/ 6.4
	11	.054/19.0	.064/19.0	.090/19.0	.122/13.7	.152/13.7	.175/ 9.8	.189/ 9.2	.193/ 9.0	.185/ 8.1	.168/ 7.7	.144/ 7.5	.120/ 7.3	.108/ 7.1
	13	.053/19.0	.062/19.0	.084/19.0	.111/19.0	.136/13.7	.157/10.5	.170/10.1	.173/ 9.8	.167/ 9.2	.153/ 9.2	.133/ 9.0	.113/ 8.7	.104/ 8.5
	15	.049/19.0	.057/19.0	.076/19.0	.099/19.0	.121/14.0	.139/13.7	.150/13.4	.153/10.8	.148/10.5	.136/ 9.8	.119/ 9.5	.103/ 9.2	.095/ 9.2
	17	.045/23.3	.052/19.0	.068/19.0	.087/19.0	.106/19.0	.122/14.3	.132/14.0	.134/13.4	.130/11.6	.120/11.2	.105/10.8	.092/10.1	.086/10.1
	19	.041/23.3	.046/23.3	.060/19.0	.077/19.0	.093/19.0	.107/15.3	.115/14.6	.118/14.3	.114/14.0	.105/13.4	.093/12.1	.081/11.2	.076/11.2
	21	.037/23.3	.041/23.3	.053/19.0	.068/19.0	.082/19.0	.093/19.0	.101/15.7	.103/15.3	.100/14.6	.092/14.3	.081/13.7	.071/13.4	.067/13.1

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 14 - SHIP B, GM = 1.5 FT, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM =1.5FT (MEMBRANE TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.202/ 7.7	.218/ 7.7	.254/ 7.7	.291/ 7.7	.322/ 7.7	.341/ 7.9	.345/ 7.9	.332/ 7.9	.305/ 7.9	.268/ 7.9	.228/ 7.9	.198/ 7.9	.187/ 7.9
	9	.274/ 9.5	.291/ 8.5	.331/ 8.5	.374/ 8.5	.411/ 8.5	.434/ 8.5	.440/ 8.5	.426/ 8.5	.397/ 8.5	.355/ 8.5	.312/ 8.5	.278/ 9.0	.267/ 9.2
	11	.286/10.5	.298/10.1	.328/ 9.8	.362/ 8.5	.391/ 8.5	.410/ 8.5	.415/ 8.5	.405/ 8.5	.382/ 8.7	.350/ 9.0	.317/ 9.8	.293/10.1	.284/10.1
	13	.268/10.8	.276/10.8	.296/10.8	.320/ 9.8	.341/ 9.0	.355/ 8.7	.359/ 8.7	.352/ 9.0	.335/ 9.0	.313/ 9.8	.290/10.5	.274/10.8	.268/10.8
	15	.239/11.6	.245/11.6	.259/11.2	.276/10.8	.291/ 9.2	.300/ 9.0	.303/ 9.0	.298/ 9.0	.286/ 9.2	.271/10.5	.255/11.2	.244/11.2	.240/11.6
	17	.210/12.1	.214/12.1	.224/11.6	.236/11.2	.246/ 9.2	.254/ 9.0	.256/ 9.0	.252/ 9.2	.244/ 9.5	.232/10.8	.221/11.6	.213/11.6	.210/12.1
	19	.182/12.6	.185/12.6	.193/12.1	.202/11.6	.210/ 9.8	.215/ 9.2	.216/ 9.2	.214/ 9.2	.207/ 9.8	.199/11.6	.191/12.1	.185/12.1	.183/12.6
	21	.158/12.8	.161/12.8	.166/12.6	.173/12.1	.179/10.8	.183/ 9.2	.184/ 9.2	.182/ 9.2	.178/10.5	.171/12.1	.165/12.6	.160/13.1	.159/13.4
5	7	.169/ 8.3	.190/ 8.3	.234/ 8.3	.279/ 8.1	.314/ 8.1	.336/ 8.1	.341/ 8.1	.329/ 7.9	.302/ 7.9	.264/ 7.9	.223/ 7.9	.193/ 7.9	.183/ 7.9
	9	.202/ 8.7	.224/ 8.5	.274/ 8.5	.329/ 8.5	.378/ 8.5	.415/ 8.3	.435/ 8.3	.438/ 8.3	.424/ 8.5	.398/ 8.5	.367/ 8.5	.344/ 8.5	.336/ 8.5
	11	.205/12.6	.222/12.1	.261/ 8.7	.308/ 8.7	.353/ 8.7	.391/ 8.7	.417/ 8.7	.430/ 8.7	.430/ 8.7	.420/ 8.7	.405/ 9.0	.394/ 9.0	.390/ 9.0
	13	.193/13.1	.204/13.1	.233/12.8	.269/ 8.7	.305/ 8.7	.338/ 8.7	.364/ 8.7	.380/ 8.7	.387/ 9.0	.386/ 9.0	.381/ 9.2	.376/ 9.2	.375/ 9.2
	15	.174/13.7	.182/13.7	.203/13.4	.230/12.8	.259/ 8.7	.286/ 8.7	.308/ 8.7	.324/ 9.0	.334/ 9.0	.337/ 9.2	.336/ 9.5	.335/ 9.5	.335/ 9.5
	17	.154/14.3	.161/14.3	.176/14.0	.197/13.4	.220/ 8.7	.242/ 8.7	.261/ 9.0	.275/ 9.0	.284/ 9.2	.289/ 9.2	.291/ 9.5	.292/ 9.8	.292/ 9.8
	19	.136/15.0	.140/15.0	.152/14.6	.169/14.0	.187/ 8.7	.205/ 8.7	.221/ 9.0	.234/ 9.0	.242/ 9.2	.248/ 9.5	.250/ 9.5	.252/ 9.8	.252/ 9.8
	21	.119/15.3	.122/15.3	.132/15.3	.145/15.0	.160/14.0	.175/ 8.7	.188/ 9.0	.199/ 9.0	.207/ 9.2	.212/ 9.5	.215/ 9.8	.217/10.1	.217/10.1
10	7	.116/ 9.8	.146/ 7.9	.202/ 7.9	.254/ 7.9	.295/ 7.9	.320/ 7.9	.328/ 7.9	.318/ 7.9	.291/ 7.7	.252/ 7.7	.209/ 7.5	.177/ 7.3	.166/ 7.3
	9	.137/ 9.8	.166/ 9.8	.224/ 8.5	.286/ 8.3	.344/ 8.3	.391/ 8.3	.424/ 8.3	.440/ 8.3	.439/ 8.1	.425/ 8.1	.404/ 8.1	.387/ 8.1	.381/ 8.1
	11	.141/15.3	.162/15.3	.209/ 8.7	.264/ 8.5	.322/ 8.5	.376/ 8.5	.422/ 8.5	.456/ 8.5	.477/ 8.5	.487/ 8.5	.489/ 8.5	.488/ 8.5	.488/ 8.5
	13	.135/15.7	.150/15.7	.185/15.3	.230/ 8.7	.280/ 8.5	.330/ 8.5	.376/ 8.5	.415/ 8.5	.445/ 8.5	.465/ 8.5	.477/ 8.5	.484/ 8.5	.486/ 8.5
	15	.125/16.5	.135/16.1	.161/16.1	.197/ 8.7	.238/ 8.7	.281/ 8.7	.322/ 8.7	.359/ 8.7	.390/ 8.7	.412/ 8.7	.428/ 8.7	.437/ 8.7	.440/ 8.7
	17	.113/17.0	.120/17.0	.140/16.5	.168/16.1	.202/ 8.7	.238/ 8.7	.274/ 8.7	.307/ 8.7	.334/ 8.7	.356/ 8.7	.372/ 9.0	.381/ 9.0	.384/ 9.0
	19	.100/17.5	.106/17.5	.122/17.0	.144/16.5	.172/ 8.7	.202/ 8.7	.233/ 8.7	.261/ 8.7	.286/ 9.0	.305/ 9.0	.319/ 9.0	.328/ 9.0	.331/ 9.0
	21	.089/18.5	.093/18.0	.106/18.0	.124/17.0	.147/ 8.7	.173/ 8.7	.198/ 8.7	.223/ 8.7	.244/ 9.0	.262/ 9.0	.274/ 9.0	.282/ 9.0	.285/ 9.0
15	7	.100/ 8.3	.135/ 8.3	.195/ 8.3	.248/ 8.1	.290/ 8.1	.316/ 7.9	.323/ 7.9	.312/ 7.7	.284/ 7.7	.243/ 7.7	.196/ 7.1	.161/ 7.0	.150/ 7.0
	9	.106/ 8.5	.137/ 8.5	.198/ 8.5	.263/ 8.5	.325/ 8.3	.378/ 8.3	.417/ 8.1	.439/ 7.9	.444/ 7.9	.435/ 7.9	.417/ 7.7	.401/ 7.7	.396/ 7.7
	11	.104/19.6	.127/19.6	.178/ 8.5	.239/ 8.5	.306/ 8.5	.372/ 8.3	.432/ 8.3	.481/ 8.3	.516/ 8.3	.539/ 8.1	.551/ 8.1	.556/ 8.1	.558/ 8.1
	13	.099/20.3	.116/20.3	.155/ 8.5	.207/ 8.5	.268/ 8.5	.332/ 8.5	.395/ 8.5	.452/ 8.3	.499/ 8.3	.536/ 8.3	.561/ 8.3	.576/ 8.3	.581/ 8.3
	15	.092/20.3	.104/20.3	.134/20.3	.177/ 8.5	.228/ 8.5	.285/ 8.5	.343/ 8.5	.398/ 8.5	.446/ 8.5	.484/ 8.5	.513/ 8.5	.530/ 8.5	.536/ 8.5
	17	.084/20.3	.093/20.3	.11[illegible]/20.3	.151/ 8.5	.194/ 8.5	.242/ 8.5	.293/ 8.5	.342/ 8.5	.386/ 8.5	.422/ 8.5	.450/ 8.5	.467/ 8.5	.472/ 8.5
	19	.075/20.9	.083/20.3	.101/20.3	.129/20.3	.165/ 8.5	.206/ 8.5	.250/ 8.5	.292/ 8.5	.331/ 8.5	.364/ 8.5	.388/ 8.5	.404/ 8.5	.409/ 8.5
	21	.067/20.9	.073/20.9	.088/20.9	.111/20.3	.141/ 8.5	.176/ 8.5	.213/ 8.5	.250/ 8.5	.284/ 8.5	.312/ 8.5	.334/ 8.5	.348/ 8.5	.352/ 8.5
20	7	.084/ 8.5	.116/ 8.5	.172/ 8.5	.223/ 8.5	.262/ 8.5	.288/ 8.5	.296/ 8.5	.288/ 8.5	.263/ 8.3	.225/ 7.0	.182/ 6.8	.147/ 6.7	.134/ 6.7
	9	.082/13.7	.112/ 8.7	.171/ 8.5	.237/ 8.5	.302/ 8.5	.359/ 8.3	.403/ 8.3	.429/ 7.7	.438/ 7.7	.431/ 7.5	.414/ 7.3	.398/ 7.3	.391/ 7.3
	11	.078/19.0	.101/19.0	.153/ 9.0	.219/ 8.5	.293/ 8.5	.369/ 8.3	.439/ 8.1	.499/ 7.9	.544/ 7.9	.574/ 7.7	.591/ 7.7	.599/ 7.7	.602/ 7.7
	13	.073/23.3	.091/23.3	.132/ 9.0	.190/ 8.5	.260/ 8.5	.337/ 8.3	.414/ 8.3	.485/ 8.1	.546/ 8.1	.594/ 8.1	.629/ 8.1	.649/ 8.1	.656/ 8.1
	15	.068/23.3	.081/23.3	.114/23.3	.162/ 8.7	.224/ 8.5	.293/ 8.3	.365/ 8.3	.435/ 8.3	.497/ 8.3	.549/ 8.3	.588/ 8.3	.612/ 8.1	.620/ 8.1
	17	.063/26.2	.073/23.3	.099/23.3	.139/ 9.0	.190/ 8.5	.251/ 8.5	.315/ 8.3	.378/ 8.3	.435/ 8.3	.484/ 8.3	.521/ 8.3	.544/ 8.3	.552/ 8.3
	19	.057/26.2	.065/26.2	.086/23.3	.119/ 9.0	.162/ 8.5	.214/ 8.5	.269/ 8.3	.324/ 8.3	.375/ 8.3	.419/ 8.3	.453/ 8.3	.474/ 8.3	.481/ 8.3
	21	.051/27.3	.058/27.3	.075/27.3	.102/19.0	.139/ 8.5	.183/ 8.5	.230/ 8.3	.278/ 8.3	.323/ 8.3	.361/ 8.3	.391/ 8.3	.409/ 8.3	.416/ 8.3

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 15 - SHIP B, GM = 3 FT, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 3 FT (MEMBRANE TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{0E}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.010/ 7.7	.010/ 7.7	.011/ 7.7	.012/ 7.5	.012/ 7.3	.013/ 7.0	.013/ 7.0	.012/ 7.0	.011/ 7.0	.010/ 7.0	.010/ 7.5	.009/ 7.5	.009/ 7.5
	9	.012/ 7.9	.012/ 7.9	.013/ 7.9	.013/ 7.9	.014/ 7.9	.014/ 7.9	.014/ 7.9	.013/ 7.7	.013/ 7.7	.012/ 7.7	.011/ 7.7	.010/ 7.7	.010/ 7.7
	11	.013/12.8	.013/12.8	.014/12.6	.015/12.6	.015/12.8	.016/12.8	.015/12.8	.015/12.8	.014/12.8	.013/13.1	.012/13.1	.011/13.1	.011/13.1
	13	.016/15.7	.017/16.1	.018/16.5	.020/20.3	.021/20.3	.022/20.3	.022/20.3	.021/20.3	.020/20.3	.018/20.9	.017/20.9	.015/20.9	.015/20.9
	15	.032/20.9	.033/20.9	.036/20.9	.040/20.9	.043/20.9	.045/20.9	.046/20.9	.044/20.9	.042/20.9	.038/20.9	.034/20.9	.031/20.9	.030/20.9
	17	.055/20.9	.058/20.9	.063/20.9	.069/20.9	.075/20.9	.079/20.9	.079/20.9	.078/20.9	.073/20.9	.067/20.9	.060/20.9	.055/20.9	.053/20.9
	19	.073/20.9	.075/20.9	.082/20.9	.091/20.9	.098/20.9	.103/20.9	.104/20.9	.102/20.9	.096/20.9	.088/20.9	.080/20.9	.073/20.9	.070/20.9
	21	.081/20.9	.084/20.9	.091/20.9	.100/20.9	.109/20.9	.114/20.9	.116/20.9	.113/20.9	.107/20.9	.098/20.9	.088/20.9	.081/20.9	.078/20.9
5	7	.015/ 9.5	.015/ 9.2	.015/ 9.2	.016/ 8.3	.016/ 8.3	.015/ 8.3	.014/ 8.3	.012/ 8.3	.010/ 7.0	.009/ 6.5	.007/ 6.4	.006/ 6.4	.006/ 6.4
	9	.017/ 9.5	.017/ 9.5	.017/ 9.5	.017/ 9.5	.017/ 9.5	.017/ 9.5	.015/ 9.2	.013/ 9.0	.011/ 9.0	.010/ 7.7	.008/ 6.7	.007/ 6.5	.007/ 6.5
	11	.018/ 9.8	.018/14.6	.019/14.3	.019/14.3	.019/14.0	.018/13.7	.017/13.4	.015/13.1	.013/12.8	.011/12.6	.009/11.6	.008/11.6	.008/11.6
	13	.028/20.9	.028/20.9	.029/20.9	.029/20.9	.029/20.9	.028/20.9	.025/20.9	.022/20.3	.018/20.3	.015/20.3	.012/14.6	.011/14.3	.010/14.0
	15	.054/20.9	.055/20.9	.057/20.9	.058/20.9	.058/20.9	.056/20.9	.052/20.9	.046/20.9	.040/20.9	.034/20.9	.029/20.9	.026/20.3	.025/20.3
	17	.081/20.9	.082/20.9	.085/20.9	.089/20.9	.092/20.9	.092/20.9	.090/20.9	.085/20.9	.078/20.9	.070/20.9	.063/20.9	.058/20.3	.057/20.3
	19	.095/20.9	.097/20.9	.102/20.9	.108/20.9	.114/20.9	.117/20.9	.117/20.9	.114/20.9	.108/20.9	.100/20.9	.092/20.9	.087/20.9	.084/20.3
	21	.098/20.9	.101/20.9	.107/20.9	.115/20.9	.122/20.9	.128/20.9	.130/20.9	.129/20.9	.124/20.9	.117/20.9	.109/20.9	.103/20.9	.100/20.3
10	7	.027/12.8	.027/12.8	.026/12.8	.025/12.8	.024/11.6	.021/10.5	.018/10.5	.014/10.5	.011/ 8.3	.008/ 8.3	.006/ 5.7	.005/ 5.7	.004/ 5.7
	9	.029/12.8	.029/12.8	.028/12.8	.027/12.8	.025/12.1	.023/12.1	.019/10.5	.015/10.5	.012/10.5	.009/ 8.7	.007/ 8.7	.006/ 8.7	.005/ 5.7
	11	.032/13.1	.032/13.1	.032/13.1	.031/13.1	.029/12.8	.026/15.7	.022/15.3	.018/15.0	.014/14.3	.010/12.8	.008/10.1	.007/10.1	.006/10.1
	13	.061/20.9	.061/20.9	.059/20.9	.056/20.9	.052/20.9	.046/20.9	.038/20.9	.029/20.9	.021/20.9	.015/20.9	.011/14.6	.008/13.4	.008/13.1
	15	.101/20.9	.101/20.9	.099/20.9	.096/20.9	.090/20.9	.082/20.9	.070/20.9	.055/20.9	.042/20.9	.030/20.9	.022/20.9	.016/20.3	.015/20.3
	17	.126/20.9	.126/20.9	.126/20.9	.126/20.9	.123/20.9	.116/20.9	.105/20.9	.090/20.9	.074/20.9	.059/20.9	.046/20.9	.035/20.3	.031/20.3
	19	.133/20.9	.134/20.9	.136/20.9	.139/20.9	.140/20.9	.137/20.9	.126/20.9	.115/20.9	.099/20.9	.082/20.9	.066/20.9	.051/20.3	.045/20.3
	21	.129/20.9	.130/20.9	.134/20.9	.140/20.9	.144/20.9	.143/20.9	.137/20.9	.126/20.9	.112/20.9	.095/20.9	.077/20.9	.060/20.3	.053/20.3
15	7	.286/20.3	.279/20.3	.260/20.3	.231/20.3	.197/20.9	.159/20.9	.111/20.9	.079/20.9	.014/10.1	.008/10.1	.005/ 6.5	.004/ 5.2	.003/ 4.8
	9	.232/20.3	.226/20.3	.210/20.3	.185/20.3	.157/20.3	.125/20.3	.086/20.3	.061/20.9	.015/14.3	.009/10.1	.006/ 7.9	.005/ 7.9	.004/ 7.9
	11	.185/[illegible]	.180/20.3	.167/20.9	.147/20.9	.124/20.9	.098/20.9	.068/20.9	.050/20.9	.018/14.3	.011/14.6	.007/ 9.5	.006/ 9.5	.005/ 9.5
	13	.171/[illegible]	.167/20.9	.156/20.9	.139/20.9	.119/20.9	.096/20.9	.069/20.9	.057/20.9	.029/20.9	.016/20.9	.010/20.3	.007/12.8	.007/12.6
	15	.167/[illegible]	[illegible]64/20.9	.155/20.9	.142/20.9	.126/20.9	.106/20.9	.083/20.9	.079/20.9	.051/20.9	.032/20.9	.020/20.9	.013/20.9	.010/20.9
	17	.158/[illegible]	[illegible]6/20.9	.151/20.9	.143/20.9	.131/20.9	.116/20.9	.096/20.9	.102/20.9	.075/20.9	.054/20.9	.037/20.9	.025/20.9	.019/20.9
	19	.144/[illegible]	[illegible]/20.9	.141/20.9	.137/20.9	.130/20.9	.120/20.9	.104/20.9	.118/20.9	.093/20.9	.071/20.9	.051/20.9	.035/20.9	.028/20.9
	21	.128/[illegible]	[illegible]/20.9	.128/20.9	.127/20.9	.124/20.9	.117/20.9	.105/20.9	.123/20.9	.101/20.9	.080/20.9	.059/20.9	.041/20.9	.032/20.9
20	7	.161/[illegible]	[illegible]/21.7	.161/21.7	.161/21.7	.156/21.7	.139/21.7	.114/21.7	.152/21.7	.080/21.7	.011/13.4	.005/ 7.5	.004/ 6.3	.003/ 5.7
	9	.148/21.[illegible]	.148/21.7	.147/21.7	.147/21.7	.141/21.7	.127/21.7	.103/21.7	.138/21.7	.072/21.7	.012/13.4	.006/ 7.5	.004/ 7.3	.004/ 7.3
	11	.128/20.9	.128/20.9	.127/20.9	.126/20.9	.121/20.9	.109/20.9	.089/20.9	.118/20.9	.063/20.9	.014/13.4	.007/ 9.2	.005/ 9.0	.005/ 9.0
	13	.122/20.9	.122/20.9	.122/20.9	.122/20.9	.117/20.9	.105/20.9	.086/20.9	.117/20.9	.065/20.9	.022/20.9	.010/20.9	.007/10.1	.006/10.1
	15	.116/20.9	.116/20.9	.118/20.9	.119/20.9	.116/20.9	.105/20.9	.088/20.9	.124/20.9	.076/20.9	.037/20.9	.019/20.9	.011/20.3	.008/20.3
	17	.106/20.9	.107/20.9	.110/20.9	.113/20.9	.112/20.9	.104/20.9	.089/20.9	.131/20.9	.089/20.9	.054/20.9	.033/20.9	.020/20.3	.015/20.3
	19	.095/20.9	.096/20.9	.101/20.9	.105/20.9	.105/20.9	.099/20.9	.088/20.9	.134/20.9	.099/20.9	.067/20.9	.044/20.9	.028/20.3	.021/20.3
	21	.083/20.9	.085/20.9	.090/20.9	.095/20.9	.097/20.9	.093/20.9	.083/20.9	.132/20.9	.101/20.9	.073/20.9	.050/20.3	.033/20.3	.024/20.3

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 16 - SHIP B, GM = 3 FT, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 3 FT (MEMBRANE TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.018/ 7.7	.018/ 7.7	.020/ 7.7	.023/ 7.7	.026/ 7.7	.028/ 7.7	.030/ 7.7	.030/ 7.7	.029/ 7.7	.028/ 7.7	.026/ 7.7	.025/ 7.7	.024/ 7.7
	9	.030/10.8	.030/10.8	.032/10.8	.034/10.5	.036/10.1	.038/ 9.8	.039/ 9.8	.040/ 9.8	.040/10.1	.039/10.5	.038/10.5	.037/10.8	.037/10.8
	11	.045/12.1	.045/12.1	.045/12.1	.044/12.1	.044/11.6	.044/11.2	.045/11.2	.046/11.2	.047/11.2	.048/11.6	.049/11.6	.050/11.6	.050/12.1
	13	.055/13.4	.054/13.4	.053/13.4	.051/13.1	.048/12.8	.047/12.6	.047/12.6	.048/12.6	.050/12.6	.053/12.8	.055/12.8	.057/12.8	.058/13.1
	15	.059/14.3	.058/14.3	.056/14.3	.053/14.3	.049/14.0	.046/13.7	.045/13.4	.047/13.4	.050/13.7	.053/14.0	.057/14.0	.060/14.0	.061/14.0
	17	.059/15.3	.058/15.3	.056/15.3	.052/15.3	.048/15.0	.044/15.0	.043/14.6	.044/14.6	.047/15.0	.052/15.0	.056/15.0	.059/15.3	.060/15.3
	19	.056/16.5	.055/16.5	.053/16.5	.049/16.5	.044/16.1	.041/16.1	.039/15.7	.040/15.7	.044/16.1	.048/16.1	.052/16.1	.055/16.1	.056/16.1
	21	.052/17.5	.051/17.5	.049/17.5	.045/17.5	.041/17.5	.037/17.5	.035/17.0	.036/17.0	.040/17.0	.044/17.5	.048/17.5	.051/17.5	.051/17.5
5	7	.017/ 9.8	.018/ 9.5	.020/ 9.5	.023/ 9.5	.026/ 8.3	.028/ 7.3	.029/ 7.3	.030/ 7.3	.029/ 7.3	.028/ 6.4	.026/ 6.4	.024/ 6.4	.024/ 6.4
	9	.030/12.8	.030/12.8	.032/12.6	.034/12.1	.036/10.5	.038/ 9.8	.039/ 9.5	.040/ 9.2	.040/ 9.2	.039/ 9.2	.038/ 9.2	.037/ 9.2	.037/ 9.5
	11	.045/13.7	.045/13.7	.044/13.7	.044/13.4	.044/13.1	.045/12.6	.045/11.2	.046/10.5	.047/10.5	.048/10.5	.050/10.5	.050/10.5	.051/10.5
	13	.[illegible]5/15.0	.054/15.0	.053/14.6	.051/14.6	.048/14.3	.047/13.7	.047/12.8	.048/12.1	.050/11.6	.053/11.6	.056/11.6	.058/11.6	.058/11.6
	15	.[illegible]9/16.1	.058/16.1	.056/15.7	.053/15.7	.049/15.3	.046/15.0	.045/14.0	.047/13.1	.050/12.8	.054/12.8	.057/12.8	.060/12.8	.061/12.8
	17	.059/17.0	.058/17.0	.055/17.0	.052/16.5	.047/16.5	.044/16.1	.043/15.0	.044/14.3	.047/14.0	.052/14.0	.056/14.0	.059/14.0	.060/14.0
	19	.056/18.0	.055/18.0	.053/18.0	.049/18.0	.044/17.5	.041/17.0	.039/16.1	.040/15.3	.044/15.0	.048/15.0	.052/15.0	.055/15.0	.056/15.0
	21	.052/19.0	.051/19.0	.049/19.0	.045/19.0	.040/18.5	.037/18.0	.035/17.5	.036/16.5	.040/16.1	.044/16.1	.048/16.1	.051/16.1	.052/16.1
10	7	.017/13.4	.018/13.4	.020/13.4	.023/13.4	.025/10.5	.027/ 7.9	.029/ 7.3	.029/ 7.0	.028/ 7.0	.027/ 7.0	.025/ 7.0	.024/ 5.2	.023/ 5.2
	9	.030/13.4	.030/13.4	.032/13.4	.034/13.4	.036/13.4	.038/12.1	.039/ 8.3	.040/ 8.3	.040/ 8.3	.039/ 8.3	.039/ 8.3	.038/ 8.3	.037/ 8.3
	11	.044/16.1	.044/16.1	.044/16.1	.044/16.1	.044/15.7	.044/15.0	.045/13.1	.046/ 9.5	.048/ 9.5	.049/ 9.5	.050/ 9.5	.051/ 9.5	.051/ 9.5
	13	.054/17.0	.054/17.0	.052/17.0	.050/17.0	.048/16.5	.047/16.1	.047/14.6	.048/11.2	.051/10.8	.054/10.5	.056/10.5	.058/10.5	.059/10.5
	15	.059/18.0	.058/18.0	.056/18.0	.052/17.5	.049/17.5	.046/17.0	.045/15.7	.047/12.8	.050/12.1	.054/11.6	.058/11.6	.060/11.6	.061/11.6
	17	.059/19.0	.058/19.0	.055/19.0	.051/18.5	.047/18.5	.044/18.0	.043/16.5	.044/14.3	.048/13.1	.052/12.8	.056/12.8	.059/12.8	.060/12.8
	19	.056/19.6	.055/19.6	.052/19.6	.048/19.6	.044/19.0	.041/18.5	.039/17.5	.040/15.3	.044/14.3	.049/14.0	.053/14.0	.056/14.0	.057/14.0
	21	.052/20.9	.051/20.9	.048/20.9	.044/20.3	.040/20.3	.037/19.6	.035/18.5	.037/16.5	.040/15.3	.044/15.0	.048/15.0	.051/15.0	.052/15.0
15	7	.017/17.5	.018/17.5	.020/17.5	.022/17.5	.025/17.5	.027/10.1	.028/10.1	.028/ 6.4	.028/ 6.4	.026/ 6.5	.024/ 6.5	.023/ 4.8	.022/ 4.8
	9	.029/19.6	.030/19.6	.031/19.6	.033/19.6	.036/17.5	.038/12.6	.039/12.6	.040/ 7.5	.040/ 7.5	.039/ 7.5	.039/ 7.5	.038/ 7.5	.038/ 7.5
	11	.044/20.3	.044/20.3	.044/20.3	.044/20.3	.044/20.3	.044/18.0	.045/15.7	.046/ 9.0	.048/ 8.7	.049/ 8.7	.051/ 8.7	.051/ 8.7	.052/ 8.7
	13	.054/20.3	.053/20.3	.052/20.3	.050/20.3	.048/20.3	.047/19.6	.047/18.0	.048/10.1	.051/ 9.8	.054/ 9.8	.057/ 9.8	.059/ 9.8	.060/ 9.8
	15	.058/20.9	.057/20.9	.055/20.9	.052/20.3	.049/20.3	.046/20.3	.045/18.5	.047/12.1	.050/11.2	.054/10.8	.058/10.8	.061/10.8	.062/10.8
	17	.058/21.7	.057/21.7	.055/20.9	.051/20.9	.047/20.9	.044/20.3	.043/19.6	.044/13.1	.048/12.6	.052/12.1	.057/12.1	.059/12.1	.061/12.1
	19	.056/21.7	.055/21.7	.052/21.7	.048/21.7	.044/21.7	.040/20.9	.039/19.6	.041/15.7	.044/13.7	.049/13.1	.053/13.1	.056/13.1	.057/13.1
	21	.051/22.4	.051/22.4	.048/22.4	.044/22.4	.040/22.4	.037/21.7	.035/18.5	.037/16.5	.040/14.6	.044/14.3	.048/14.3	.051/14.3	.052/14.3
20	7	.017/41.9	.018/13.4	.020/13.4	.022/13.4	.025/13.4	.026/13.4	.028/13.4	.028/13.4	.027/ 6.3	.025/ 6.3	.023/ 6.3	.022/ 6.3	.021/ 4.2
	9	.029/23.3	.030/19.0	.031/19.0	.033/19.0	.035/19.0	.037/19.0	.039/19.0	.040/ 7.0	.040/ 7.0	.039/ 6.8	.038/ 6.8	.038/ 6.8	.037/ 6.8
	11	.044/23.3	.044/23.3	.044/23.3	.044/23.3	.044/19.0	.044/19.0	.045/19.0	.046/ 7.9	.048/ 7.9	.050/ 7.7	.051/ 7.7	.052/ 7.7	.052/ 7.7
	13	.054/23.3	.053/23.3	.052/23.3	.050/23.3	.048/23.3	.046/23.3	.047/19.0	.048/ 9.5	.051/ 9.2	.054/ 9.0	.057/ 9.0	.059/ 9.0	.060/ 9.0
	15	.058/26.2	.057/26.2	.055/26.2	.052/26.2	.048/23.3	.046/23.3	.045/23.3	.047/10.5	.050/10.1	.055/10.1	.059/10.1	.061/10.1	.062/10.1
	17	.058/26.2	.057/26.2	.055/26.2	.051/26.2	.047/26.2	.044/23.3	.043/23.3	.044/11.6	.048/11.2	.053/11.2	.057/11.2	.060/11.2	.061/11.2
	19	.055/27.3	.054/27.3	.052/27.3	.048/26.2	.044/26.2	.040/23.3	.039/23.3	.041/14.6	.044/12.6	.049/12.6	.053/12.1	.056/12.1	.057/12.1
	21	.051/27.3	.050/27.3	.048/27.3	.044/27.3	.040/26.2	.037/23.3	.035/23.3	.037/15.3	.040/14.3	.044/13.7	.049/13.4	.051/13.4	.052/13.4

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 17 - SHIP B, GM = 3 FT, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 3 FT (MEMBRANE TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.047/ 8.3	.061/ 7.9	.092/ 7.7	.125/ 7.3	.153/ 7.1	.173/ 7.0	.183/ 7.0	.181/ 7.0	.169/ 7.0	.146/ 7.0	.116/ 7.0	.085/ 7.0	.069/ 7.1
	9	.071/ 9.5	.083/ 9.5	.111/ 9.2	.143/ 9.0	.170/ 8.7	.189/ 8.7	.198/ 8.5	.195/ 8.5	.181/ 8.5	.157/ 8.7	.127/ 9.0	.097/ 9.2	.083/ 9.5
	11	.080/10.5	.091/10.5	.114/10.1	.141/10.1	.165/ 9.8	.181/ 9.8	.188/ 9.8	.185/ 9.8	.172/ 9.8	.150/ 9.8	.124/10.1	.099/10.5	.088/10.5
	13	.080/11.6	.088/11.2	.108/11.2	.131/10.8	.151/10.8	.165/10.8	.170/10.8	.167/10.8	.155/10.8	.137/10.8	.114/11.2	.094/11.2	.085/11.6
	15	.075/12.6	.082/12.6	.098/12.1	.117/12.1	.135/12.1	.146/12.1	.151/12.1	.148/12.1	.138/12.1	.122/12.1	.103/12.1	.086/12.6	.079/12.6
	17	.068/13.4	.074/13.4	.088/13.4	.104/13.4	.119/13.4	.129/13.4	.133/13.4	.130/13.4	.122/13.4	.108/13.7	.092/14.0	.077/14.0	.071/14.0
	19	.061/14.0	.066/14.0	.078/14.0	.092/14.3	.104/14.6	.113/14.6	.117/14.6	.114/15.0	.107/15.0	.095/15.0	.081/15.0	.069/15.0	.064/15.0
	21	.054/15.3	.058/15.7	.068/15.7	.080/15.7	.091/15.7	.099/15.7	.102/16.1	.100/16.1	.094/16.1	.083/16.1	.071/16.1	.061/16.1	.057/16.1
5	7	.045/ 8.7	.059/ 8.5	.090/ 7.5	.124/ 7.3	.154/ 7.3	.175/ 7.1	.186/ 7.0	.186/ 7.0	.174/ 6.8	.152/ 6.8	.123/ 6.8	.091/ 6.8	.075/ 7.0
	9	.067/10.8	.079/10.5	.108/ 9.8	.140/ 9.2	.169/ 9.0	.190/ 8.7	.200/ 8.5	.199/ 8.5	.186/ 8.3	.163/ 8.3	.134/ 8.3	.104/ 8.3	.090/ 8.5
	11	.075/12.1	.085/11.6	.109/11.2	.137/10.8	.162/10.5	.181/10.1	.189/ 9.8	.188/ 9.5	.176/ 9.5	.156/ 9.5	.130/ 9.5	.105/ 9.5	.094/ 9.5
	13	.074/12.8	.083/12.6	.103/12.6	.126/12.1	.148/11.6	.163/11.2	.171/10.8	.169/10.8	.159/10.5	.142/10.5	.120/10.5	.099/10.5	.091/10.5
	15	.070/13.7	.076/13.4	.093/13.1	.113/13.1	.131/12.8	.145/12.6	.151/12.1	.150/11.6	.141/11.6	.126/11.6	.108/11.2	.091/11.2	.084/11.2
	17	.063/14.6	.069/14.3	.083/14.0	.100/14.0	.116/13.7	.127/13.4	.133/13.4	.132/13.4	.124/13.4	.112/13.1	.096/13.1	.082/12.8	.076/12.6
	19	.056/15.7	.061/15.7	.073/15.3	.088/15.3	.102/15.3	.112/15.0	.117/15.0	.116/14.6	.109/14.6	.098/14.3	.085/14.3	.073/14.3	.068/14.3
	21	.050/16.5	.054/16.5	.065/16.1	.077/16.1	.089/16.1	.098/16.1	.102/15.7	.101/15.7	.096/15.7	.086/15.3	.075/15.3	.064/15.3	.060/15.3
10	7	.041/ 9.8	.056/ 9.5	.087/ 7.9	.122/ 7.7	.153/ 7.3	.175/ 6.7	.187/ 6.7	.188/ 6.4	.177/ 6.4	.155/ 6.4	.126/ 6.3	.095/ 6.4	.078/ 6.4
	9	.061/12.1	.074/11.6	.103/10.5	.136/ 9.8	.167/ 8.7	.189/ 8.5	.201/ 8.1	.201/ 7.9	.190/ 7.9	.168/ 7.7	.139/ 7.5	.110/ 7.5	.095/ 7.5
	11	.069/13.7	.079/13.4	.103/12.6	.132/11.6	.159/10.5	.179/10.1	.190/ 9.8	.190/ 9.2	.180/ 9.0	.161/ 9.0	.135/ 8.7	.111/ 8.7	.100/ 8.7
	13	.068/14.6	.076/14.3	.097/13.7	.121/13.1	.144/12.1	.161/11.6	.171/10.8	.171/10.5	.162/10.1	.146/ 9.8	.125/ 9.8	.105/ 9.5	.096/ 9.5
	15	.063/15.3	.070/15.3	.087/15.0	.109/14.0	.128/13.4	.143/13.1	.151/12.6	.151/11.6	.144/11.2	.130/10.8	.112/10.8	.095/10.5	.088/10.5
	17	.057/16.1	.063/16.1	.078/15.7	.096/15.3	.113/14.6	.126/14.0	.133/13.7	.133/13.4	.127/12.8	.115/12.1	.100/12.1	.085/11.6	.079/11.6
	19	.051/17.0	.056/16.5	.069/16.5	.085/16.1	.099/15.7	.110/15.3	.116/15.0	.117/14.6	.111/14.0	.101/14.0	.088/13.7	.076/13.4	.071/13.4
	21	.045/18.5	.050/18.5	.061/17.0	.074/17.0	.087/16.5	.096/16.1	.102/16.1	.102/15.7	.097/15.3	.089/15.3	.077/14.6	.067/14.6	.063/14.6
15	7	.039/14.3	.053/14.3	.085/ 8.5	.120/ 8.5	.152/ 6.3	.175/ 6.3	.188/ 6.3	.190/ 6.3	.179/ 6.3	.158/ 5.7	.128/ 5.7	.096/ 5.7	.080/ 5.7
	9	.056/14.6	.068/14.6	.098/11.6	.132/ 9.2	.164/ 8.7	.188/ 8.5	.202/ 8.3	.203/ 7.3	.193/ 7.1	.172/ 7.1	.143/ 7.0	.114/ 7.0	.100/ 7.0
	11	.062/17.5	.072/17.5	.097/14.6	.127/12.1	.156/11.6	.177/ 9.2	.190/ 9.2	.192/ 9.0	.183/ 8.7	.165/ 8.5	.140/ 8.3	.116/ 8.1	.104/ 7.9
	13	.060/17.5	.069/17.5	.090/15.0	.116/14.6	.140/12.6	.159/12.1	.171/11.2	.173/10.1	.165/ 9.5	.150/ 9.5	.129/ 9.2	.109/ 9.0	.100/ 9.0
	15	.056/17.5	.063/17.5	.081/17.5	.103/15.0	.125/15.0	.141/12.8	.151/12.6	.153/11.6	.147/11.2	.133/10.5	.116/10.1	.099/ 9.8	.092/ 9.8
	17	.051/17.5	.057/17.5	.072/17.5	.092/17.5	.110/15.3	.124/15.0	.132/14.3	.134/13.1	.129/12.6	.118/11.6	.103/11.2	.089/10.8	.083/10.8
	19	.045/19.6	.051/19.6	.064/17.5	.080/17.5	.096/17.5	.109/15.7	.116/15.3	.118/14.6	.113/14.0	.104/13.7	.091/13.1	.079/12.1	.074/12.1
	21	.040/19.6	.045/19.6	.056/19.6	.071/19.6	.084/17.5	.095/17.5	.101/16.1	.103/15.7	.099/15.3	.091/14.6	.080/14.3	.069/14.0	.065/14.0
20	7	.035/13.4	.049/13.4	.082/13.4	.118/13.4	.150/13.4	.174/ 6.3	.188/ 5.7	.190/ 5.7	.180/ 5.7	.159/ 5.7	.129/ 5.7	.097/ 5.7	.080/ 5.2
	9	.049/19.0	.062/19.0	.092/13.4	.128/13.4	.161/13.4	.186/ 7.0	.201/ 7.0	.204/ 7.0	.195/ 6.8	.175/ 6.7	.147/ 6.7	.117/ 6.4	.103/ 6.4
	11	.053/19.0	.064/19.0	.090/19.0	.122/13.7	.152/13.4	.175/ 9.8	.190/ 9.2	.193/ 9.0	.186/ 8.1	.168/ 7.7	.144/ 7.5	.120/ 7.3	.108/ 7.3
	13	.052/19.0	.061/19.0	.083/19.0	.111/19.0	.137/13.7	.157/10.5	.170/10.1	.174/ 9.8	.168/ 9.2	.153/ 9.2	.133/ 9.0	.113/ 8.7	.104/ 8.5
	15	.048/19.0	.056/19.0	.075/19.0	.099/19.0	.121/14.0	.139/13.7	.150/13.4	.154/10.8	.149/10.5	.136/10.1	.119/ 9.5	.103/ 9.5	.095/ 9.2
	17	.044/23.3	.051/19.0	.067/19.0	.087/19.0	.106/19.0	.122/14.3	.132/14.0	.135/13.4	.131/11.6	.120/11.2	.106/10.8	.092/10.1	.086/10.1
	19	.040/23.3	.045/23.3	.060/19.0	.077/19.0	.093/19.0	.107/15.3	.116/14.6	.118/14.3	.115/14.0	.106/13.4	.093/12.1	.081/11.2	.076/11.2
	21	.035/23.3	.040/23.3	.052/19.0	.067/19.0	.082/19.0	.094/19.0	.101/15.7	.103/15.3	.100/15.0	.093/14.3	.082/14.0	.072/13.4	.067/13.1

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 18 - SHIP B, GM = 3 FT, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 3 FT (MEMBRANE TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.202/ 7.7	.218/ 7.7	.254/ 7.7	.292/ 7.7	.323/ 7.7	.342/ 7.9	.345/ 7.9	.332/ 7.9	.306/ 7.9	.268/ 7.9	.228/ 7.9	.198/ 7.9	.187/ 7.9
	9	.275/ 9.5	.292/ 8.5	.331/ 8.5	.375/ 8.5	.411/ 8.5	.434/ 8.5	.440/ 8.5	.427/ 8.5	.397/ 8.5	.356/ 8.5	.312/ 8.5	.279/ 9.0	.267/ 9.2
	11	.286/10.5	.299/10.1	.328/ 9.8	.362/ 8.5	.392/ 8.5	.411/ 8.5	.415/ 8.5	.406/ 8.5	.383/ 8.7	.351/ 9.0	.318/ 9.8	.293/10.1	.284/10.1
	13	.268/10.8	.277/10.8	.297/10.8	.321/ 9.8	.342/ 9.0	.355/ 8.7	.359/ 8.7	.352/ 9.0	.336/ 9.0	.313/ 9.8	.291/10.5	.274/10.8	.268/10.8
	15	.240/11.6	.245/11.6	.259/11.2	.276/10.8	.291/ 9.2	.301/ 9.0	.303/ 9.0	.298/ 9.0	.287/ 9.2	.271/10.5	.255/11.2	.244/11.2	.240/11.6
	17	.210/12.1	.214/12.1	.224/11.6	.236/11.2	.247/ 9.2	.254/ 9.0	.256/ 9.0	.252/ 9.2	.244/ 9.5	.233/10.8	.221/11.6	.213/11.6	.211/12.1
	19	.183/12.6	.186/12.6	.193/12.1	.202/11.6	.210/ 9.8	.215/ 9.2	.217/ 9.2	.214/ 9.2	.208/ 9.6	.199/11.6	.191/12.1	.185/12.1	.183/12.6
	21	.158/12.8	.161/12.8	.166/12.6	.173/12.1	.179/10.8	.183/ 9.2	.185/ 9.2	.183/ 9.2	.178/10.5	.171/12.1	.165/12.6	.161/13.1	.159/13.4
5	7	.170/ 8.3	.191/ 8.3	.234/ 8.3	.279/ 8.1	.315/ 8.1	.336/ 8.1	.341/ 8.1	.329/ 7.9	.302/ 7.9	.264/ 7.9	.223/ 7.9	.193/ 7.9	.183/ 7.9
	9	.202/ 8.7	.225/ 8.5	.274/ 8.5	.329/ 8.5	.378/ 8.5	.415/ 8.3	.436/ 8.3	.439/ 8.3	.425/ 8.5	.398/ 8.5	.368/ 8.5	.344/ 8.5	.336/ 8.5
	11	.205/12.6	.222/12.1	.261/ 8.7	.308/ 8.7	.353/ 8.7	.391/ 8.7	.418/ 8.7	.431/ 8.7	.431/ 8.7	.420/ 8.7	.406/ 9.0	.394/ 9.0	.390/ 9.0
	13	.193/13.1	.205/13.1	.233/12.8	.269/ 8.7	.306/ 8.7	.338/ 8.7	.364/ 8.7	.380/ 8.7	.387/ 9.0	.386/ 9.0	.381/ 9.2	.377/ 9.2	.375/ 9.2
	15	.174/13.7	.183/13.7	.203/13.4	.230/12.8	.259/ 8.7	.286/ 8.7	.309/ 8.7	.325/ 9.0	.334/ 9.0	.337/ 9.2	.337/ 9.5	.336/ 9.5	.336/ 9.5
	17	.155/14.3	.161/14.3	.176/14.0	.197/13.4	.220/ 8.7	.242/ 8.7	.261/ 9.0	.275/ 9.0	.285/ 9.2	.290/ 9.2	.292/ 9.5	.292/ 9.8	.292/ 9.8
	19	.136/15.0	.140/15.0	.153/14.6	.169/14.0	.187/ 8.7	.205/ 8.7	.221/ 9.0	.234/ 9.0	.243/ 9.2	.248/ 9.5	.251/ 9.5	.252/ 9.8	.252/ 9.8
	21	.119/15.3	.122/15.3	.132/15.3	.145/15.0	.160/14.0	.175/ 8.7	.189/ 9.0	.200/ 9.0	.208/ 9.2	.213/ 9.5	.216/ 9.8	.217/10.1	.218/10.1
10	7	.116/ 9.8	.146/ 7.9	.202/ 7.9	.254/ 7.9	.295/ 7.9	.320/ 7.9	.328/ 7.9	.318/ 7.9	.291/ 7.7	.253/ 7.7	.210/ 7.5	.177/ 7.3	.167/ 7.3
	9	.138/ 9.8	.166/ 9.8	.224/ 8.5	.286/ 8.3	.344/ 8.3	.392/ 8.3	.425/ 8.3	.441/ 8.3	.440/ 8.1	.425/ 8.1	.405/ 8.1	.388/ 8.1	.382/ 8.1
	11	.141/15.3	.162/15.3	.209/ 8.7	.264/ 8.5	.322/ 8.5	.377/ 8.5	.423/ 8.5	.457/ 8.5	.478/ 8.5	.488/ 8.5	.490/ 8.5	.489/ 8.5	.489/ 8.5
	13	.136/15.7	.150/15.7	.185/15.3	.230/ 8.7	.280/ 8.5	.330/ 8.5	.377/ 8.5	.416/ 8.5	.445/ 8.5	.466/ 8.5	.478/ 8.5	.485/ 8.5	.487/ 8.5
	15	.125/16.5	.135/16.1	.161/16.1	.197/ 8.7	.238/ 8.7	.281/ 8.7	.323/ 8.7	.360/ 8.7	.390/ 8.7	.413/ 8.7	.428/ 8.7	.438/ 8.7	.441/ 8.7
	17	.113/17.0	.120/17.0	.140/16.5	.168/16.1	.202/ 8.7	.238/ 8.7	.274/ 8.7	.307/ 8.7	.335/ 8.7	.357/ 8.7	.372/ 9.0	.382/ 9.0	.385/ 9.0
	19	.100/17.5	.106/17.5	.122/17.0	.144/16.5	.172/ 8.7	.202/ 8.7	.233/ 8.7	.261/ 8.7	.286/ 9.0	.306/ 9.0	.320/ 9.0	.329/ 9.0	.332/ 9.0
	21	.089/18.5	.093/18.0	.106/18.0	.124/17.0	.147/ 8.7	.173/ 8.7	.199/ 8.7	.223/ 8.7	.245/ 9.0	.262/ 9.0	.275/ 9.0	.283/ 9.0	.285/ 9.0
15	7	.100/ 8.3	.135/ 8.3	.195/ 8.3	.249/ 8.1	.290/ 8.1	.316/ 7.9	.323/ 7.9	.312/ 7.7	.284/ 7.7	.243/ 7.7	.197/ 7.1	.162/ 7.0	.150/ 7.0
	9	.106/ 8.5	.137/ 8.5	.198/ 8.5	.263/ 8.5	.325/ 8.3	.378/ 8.3	.418/ 8.1	.440/ 7.9	.445/ 7.9	.435/ 7.9	.418/ 7.7	.402/ 7.7	.397/ 7.7
	11	.104/19.6	.127/19.6	.178/ 8.5	.240/ 8.5	.306/ 8.5	.373/ 8.3	.432/ 8.3	.481/ 8.3	.517/ 8.3	.540/ 8.1	.551/ 8.1	.557/ 8.1	.559/ 8.1
	13	.099/20.3	.116/20.3	.155/ 8.5	.207/ 8.5	.268/ 8.5	.332/ 8.5	.395/ 8.5	.452/ 8.3	.500/ 8.3	.536/ 8.3	.562/ 8.3	.577/ 8.3	.582/ 8.3
	15	.092/20.3	.104/20.3	.134/20.3	.177/ 8.5	.228/ 8.5	.285/ 8.5	.344/ 8.5	.398/ 8.5	.446/ 8.5	.485/ 8.5	.514/ 8.5	.531/ 8.5	.537/ 8.5
	17	.084/20.3	.093/20.3	.117/20.3	.151/ 8.5	.194/ 8.5	.243/ 8.5	.294/ 8.5	.343/ 8.5	.387/ 8.5	.423/ 8.5	.450/ 8.5	.467/ 8.5	.473/ 8.5
	19	.075/20.3	.083/20.3	.101/20.3	.129/20.3	.165/ 8.5	.207/ 8.5	.250/ 8.5	.293/ 8.5	.332/ 8.5	.364/ 8.5	.389/ 8.5	.404/ 8.5	.410/ 8.5
	21	.067/20.9	.073/20.9	.088/20.9	.111/20.3	.141/ 8.5	.176/ 8.5	.214/ 8.5	.251/ 8.5	.284/ 8.5	.313/ 8.5	.334/ 8.5	.348/ 8.5	.353/ 8.5
20	7	.084/ 8.5	.117/ 8.5	.172/ 8.5	.223/ 8.5	.263/ 8.5	.288/ 8.5	.297/ 8.5	.288/ 8.5	.263/ 8.3	.226/ 7.0	.182/ 6.8	.147/ 6.7	.135/ 6.7
	9	.082/13.7	.113/ 8.7	.171/ 8.5	.237/ 8.5	.302/ 8.5	.359/ 8.3	.403/ 8.3	.430/ 7.7	.439/ 7.7	.432/ 7.5	.415/ 7.3	.398/ 7.3	.392/ 7.3
	11	.078/19.0	.101/19.0	.153/ 9.0	.219/ 8.5	.293/ 8.5	.369/ 8.3	.440/ 8.1	.499/ 7.9	.545/ 7.9	.575/ 7.7	.592/ 7.7	.600/ 7.7	.603/ 7.7
	13	.073/23.3	.091/23.3	.133/ 9.0	.190/ 8.5	.261/ 8.5	.338/ 8.3	.415/ 8.3	.486/ 8.1	.547/ 8.1	.595/ 8.1	.630/ 8.1	.650/ 8.1	.657/ 8.1
	15	.068/23.3	.081/23.3	.114/23.3	.163/ 8.7	.224/ 8.5	.293/ 8.3	.366/ 8.3	.436/ 8.3	.498/ 8.3	.550/ 8.3	.589/ 8.3	.613/ 8.1	.621/ 8.1
	17	.063/26.2	.073/23.3	.099/23.3	.139/ 9.0	.191/ 8.5	.251/ 8.5	.315/ 8.3	.378/ 8.3	.436/ 8.3	.485/ 8.3	.522/ 8.3	.545/ 8.3	.553/ 8.3
	19	.057/26.2	.065/26.2	.086/23.3	.119/ 9.0	.163/ 8.5	.214/ 8.5	.270/ 8.3	.325/ 8.3	.376/ 8.3	.420/ 8.3	.453/ 8.3	.474/ 8.3	.482/ 8.3
	21	.051/27.3	.058/27.3	.075/27.3	.102/19.0	.139/ 8.5	.183/ 8.5	.231/ 8.3	.279/ 8.3	.323/ 8.3	.362/ 8.3	.391/ 8.3	.410/ 8.3	.416/ 8.3

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 19 - SHIP B, GM = 6 FT, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 6 FT (MEMBRANE TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.012/ 7.7	.012/ 7.7	.013/ 7.7	.014/ 7.7	.015/ 7.7	.015/ 7.7	.015/ 7.7	.014/ 7.5	.013/ 7.5	.012/ 7.7	.011/ 7.7	.011/ 7.7	.010/ 7.7
	9	.020/14.6	.021/14.6	.024/14.6	.028/14.3	.031/14.3	.033/12.1	.033/12.1	.032/14.3	.030/14.3	.026/14.3	.023/14.6	.020/14.6	.018/14.6
	11	.071/15.0	.074/15.0	.084/15.0	.095/15.0	.105/15.0	.112/15.0	.114/15.0	.111/15.0	.104/15.0	.094/15.0	.083/15.0	.074/15.0	.070/15.0
	13	.131/15.0	.139/15.0	.154/15.0	.174/15.0	.191/15.0	.203/15.0	.207/15.0	.203/15.0	.191/15.0	.173/15.0	.153/15.0	.137/15.0	.131/15.0
	15	.158/15.0	.166/15.0	.185/15.0	.208/15.0	.229/15.0	.243/15.0	.248/15.0	.242/15.0	.228/15.0	.207/15.0	.184/15.0	.165/15.0	.157/15.0
	17	.157/15.0	.165/15.0	.184/15.0	.208/15.0	.228/15.0	.242/15.0	.247/15.0	.242/15.0	.227/15.0	.206/15.0	.183/15.0	.164/15.0	.157/15.0
	19	.145/15.0	.152/15.0	.170/15.0	.191/15.0	.211/15.0	.223/15.0	.228/15.0	.223/15.0	.210/15.0	.190/15.0	.169/15.0	.152/15.0	.145/15.0
	21	.129/15.0	.136/15.0	.152/15.0	.171/15.0	.188/15.0	.199/15.0	.203/15.0	.199/15.0	.187/15.0	.170/15.0	.151/15.0	.135/15.0	.129/15.0
5	7	.020/ 9.5	.020/ 9.5	.021/ 9.5	.021/ 9.2	.020/ 9.0	.019/ 9.0	.017/ 9.0	.015/ 8.5	.012/ 8.5	.010/ 8.7	.008/ 6.4	.007/ 6.4	.007/ 6.4
	9	.042/15.0	.043/15.0	.044/15.0	.046/14.6	.046/14.6	.044/14.6	.040/14.6	.035/14.6	.029/14.6	.022/11.6	.017/11.2	.013/11.2	.012/10.8
	11	.119/15.0	.121/15.0	.127/15.0	.133/15.0	.136/15.0	.133/15.0	.125/15.0	.111/15.0	.094/15.0	.076/14.6	.059/14.6	.047/14.6	.042/14.6
	13	.169/15.0	.174/15.0	.188/15.0	.203/15.0	.214/15.0	.217/15.0	.210/15.0	.195/15.0	.174/15.0	.149/15.0	.125/15.0	.107/15.0	.100/15.0
	15	.177/15.0	.184/15.0	.202/15.0	.223/15.0	.240/15.0	.248/15.0	.247/15.0	.235/15.0	.215/15.0	.190/15.0	.164/15.0	.144/15.0	.137/15.0
	17	.165/15.0	.173/15.0	.191/15.0	.213/15.0	.232/15.0	.243/15.0	.245/15.0	.237/15.0	.220/15.0	.197/15.0	.173/15.0	.154/15.0	.147/15.0
	19	.146/15.0	.153/15.0	.171/15.0	.192/15.0	.211/15.0	.222/15.0	.226/15.0	.220/15.0	.206/15.0	.186/15.0	.164/15.0	.147/15.0	.141/15.0
	21	.127/15.0	.134/15.0	.150/15.0	.169/15.0	.186/15.0	.197/15.0	.201/15.0	.197/15.0	.185/15.0	.168/15.0	.149/15.0	.134/15.0	.129/15.0
10	7	.061/12.8	.060/12.8	.056/12.8	.051/12.8	.045/12.8	.037/12.1	.029/12.1	.021/10.5	.014/10.5	.009/ 8.7	.007/ 8.7	.005/ 5.7	.005/ 5.7
	9	.114/15.0	.113/15.0	.110/15.0	.105/15.0	.097/15.0	.085/14.6	.071/14.6	.054/14.6	.037/14.6	.024/14.6	.015/11.2	.010/10.1	.008/ 9.8
	11	.174/15.0	.177/15.0	.183/15.0	.188/15.0	.187/15.0	.178/15.0	.158/15.0	.132/15.0	.101/15.0	.072/14.6	.048/14.6	.032/14.6	.027/14.6
	13	.191/15.0	.198/15.0	.215/15.0	.233/15.0	.243/15.0	.241/15.0	.227/15.0	.202/15.0	.170/15.0	.135/15.0	.103/14.6	.080/14.6	.071/14.6
	15	.180/15.0	.189/15.0	.212/15.0	.236/15.0	.253/15.0	.259/15.0	.253/15.0	.234/15.0	.207/15.0	.175/15.0	.143/15.0	.120/15.0	.111/15.0
	17	.158/15.0	.168/15.0	.192/15.0	.218/15.0	.238/15.0	.248/15.0	.247/15.0	.235/15.0	.213/15.0	.185/15.0	.158/15.0	.136/15.0	.128/15.0
	19	.136/15.0	.146/15.0	.168/15.0	.193/15.0	.213/15.0	.225/15.0	.227/15.0	.218/15.0	.201/15.0	.178/15.0	.154/15.0	.136/15.0	.128/15.0
	21	.117/15.0	.125/15.0	.145/15.0	.168/15.0	.187/15.0	.199/15.0	.202/15.0	.196/15.0	.182/15.0	.163/15.0	.143/15.0	.127/15.0	.120/15.0
15	7	.128/14.3	.128/14.3	.128/14.3	.127/14.3	.122/14.3	.110/14.3	.089/14.3	.087/14.3	.047/14.3	.011/10.1	.006/ 9.2	.004/ 4.8	.004/ 4.8
	9	.139/14.3	.140/14.3	.143/14.3	.145/14.3	.141/14.3	.129/14.3	.108/14.3	.111/14.3	.069/15.0	.032/15.0	.015/14.6	.008/ 9.8	.007/ 9.2
	11	.139/15.0	.143/15.0	.155/15.0	.165/15.0	.169/15.0	.161/15.0	.144/15.0	.163/15.0	.120/15.0	.078/15.0	.045/15.0	.025/14.6	.018/14.6
	13	.128/15.0	.136/15.0	.156/15.0	.174/15.0	.185/15.0	.185/15.0	.174/15.0	.210/15.0	.172/15.0	.129/15.0	.091/15.0	.063/14.6	.052/14.6
	15	.112/15.0	.122/15.0	.144/15.0	.167/15.0	.183/15.0	.188/15.0	.184/15.0	.232/15.0	.201/15.0	.164/15.0	.128/15.0	.100/15.0	.089/14.6
	17	.096/15.0	.105/15.0	.128/15.0	.151/15.0	.168/15.0	.177/15.0	.177/15.0	.230/15.0	.207/15.0	.176/15.0	.145/15.0	.120/15.0	.110/15.0
	19	.081/15.0	.090/15.0	.110/15.0	.132/15.0	.149/15.0	.160/15.0	.162/15.0	.214/15.0	.196/15.0	.171/15.0	.145/15.0	.124/15.0	.115/15.0
	21	.069/15.0	.077/15.0	.095/15.0	.115/15.0	.131/15.0	.141/15.0	.144/15.0	.193/15.0	.179/15.0	.158/15.0	.136/15.0	.118/15.0	.111/15.0
20	7	.051/13.4	.054/13.4	.061/13.4	.067/13.4	.069/13.4	.067/13.4	.060/13.4	.091/13.4	.065/13.4	.034/13.4	.006/10.1	.004/ 4.5	.003/ 4.5
	9	.078/15.0	.083/15.0	.095/15.0	.106/15.0	.110/15.0	.107/15.0	.096/15.0	.149/15.0	.107/15.0	.059/15.0	.017/14.6	.007/ 9.5	.005/ 9.0
	11	.087/15.0	.095/15.0	.112/15.0	.127/15.0	.134/15.0	.132/15.0	.121/15.0	.193/15.0	.146/15.0	.092/15.0	.045/15.0	.021/14.6	.014/14.6
	13	.081/15.0	.090/15.0	.110/15.0	.128/15.0	.138/15.0	.139/15.0	.132/15.0	.220/15.0	.178/15.0	.128/15.0	.082/15.0	.052/14.6	.040/14.6
	15	.070/15.0	.080/15.0	.100/15.0	.119/15.0	.131/15.0	.136/15.0	.133/15.0	.230/15.0	.197/15.0	.156/15.0	.115/15.0	.085/14.6	.073/14.6
	17	.060/15.0	.068/15.0	.087/15.0	.106/15.0	.119/15.0	.126/15.0	.126/15.0	.225/15.0	.200/15.0	.167/15.0	.133/15.0	.107/15.0	.096/14.6
	19	.050/15.0	.058/15.0	.075/15.0	.092/15.0	.105/15.0	.113/15.0	.115/15.0	.209/15.0	.190/15.0	.164/15.0	.136/15.0	.114/15.0	.105/15.0
	21	.043/15.0	.050/15.0	.064/15.0	.080/15.0	.092/15.0	.100/15.0	.102/15.0	.188/15.0	.174/15.0	.153/15.0	.130/15.0	.111/15.0	.104/15.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 20 - SHIP B, GM = 6 FT, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 6 FT (MEMBRANE TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.018/ 7.7	.018/ 7.7	.021/ 7.7	.024/ 7.7	.027/ 7.5	.029/ 7.0	.030/ 7.0	.031/ 7.0	.030/ 7.5	.029/ 7.7	.027/ 7.7	.026/ 7.7	.025/ 7.7
	9	.028/10.8	.029/10.8	.030/10.8	.033/10.8	.035/10.5	.037/ 9.8	.039/ 9.8	.039/ 9.8	.039/10.1	.039/10.5	.038/10.5	.037/10.8	.037/10.8
	11	.042/12.1	.042/12.1	.042/12.1	.042/12.1	.042/11.6	.043/11.6	.044/11.2	.045/11.2	.046/11.6	.047/11.6	.048/11.6	.049/12.1	.049/12.1
	13	.052/13.4	.052/13.4	.051/13.4	.049/13.1	.047/12.8	.045/12.6	.045/12.6	.046/12.6	.048/12.6	.051/12.8	.054/12.8	.056/13.1	.056/13.1
	15	.057/14.3	.056/14.3	.054/14.3	.051/14.3	.047/14.0	.045/14.0	.044/13.7	.045/13.7	.048/13.7	.052/14.0	.056/14.0	.058/14.3	.059/14.3
	17	.057/15.3	.056/15.3	.054/15.3	.050/15.3	.046/15.3	.043/15.0	.041/15.0	.043/15.0	.046/15.0	.050/15.0	.054/15.3	.057/15.3	.058/15.3
	19	.055/16.5	.054/16.5	.051/16.5	.048/16.5	.043/16.1	.040/16.1	.038/16.1	.039/16.1	.043/16.1	.047/16.1	.051/16.1	.054/16.1	.055/16.1
	21	.051/17.5	.050/17.5	.047/17.5	.044/17.5	.039/17.5	.036/17.5	.034/17.0	.036/17.0	.039/17.5	.043/17.5	.047/17.5	.049/17.5	.050/17.5
5	7	.017/ 9.8	.017/ 9.8	.020/ 9.5	.023/ 9.5	.026/ 7.3	.028/ 7.3	.030/ 7.3	.031/ 7.1	.030/ 7.0	.029/ 6.4	.027/ 6.4	.026/ 6.4	.025/ 6.3
	9	.028/12.8	.029/12.8	.030/12.6	.033/12.1	.035/10.5	.037/10.1	.039/ 9.2	.040/ 9.0	.040/ 9.0	.040/ 9.0	.039/ 9.2	.038/ 9.2	.038/ 9.2
	11	.043/14.0	.043/14.0	.043/13.7	.043/13.7	.043/13.1	.043/12.6	.044/11.6	.045/10.8	.046/10.5	.048/10.5	.049/10.5	.049/10.5	.050/10.5
	13	.053/15.0	.052/15.0	.051/15.0	.049/14.6	.047/14.3	.045/14.0	.045/12.8	.047/12.1	.049/11.6	.052/11.6	.054/11.6	.056/11.6	.057/11.6
	15	.057/16.1	.057/16.1	.054/15.7	.051/15.7	.048/15.3	.045/15.0	.044/14.0	.045/13.1	.048/12.8	.052/12.8	.056/12.8	.058/12.8	.059/12.8
	17	.058/17.0	.057/17.0	.054/17.0	.050/17.0	.046/16.5	.043/16.1	.042/15.3	.043/14.3	.046/14.0	.050/14.0	.054/14.0	.057/14.0	.058/14.0
	19	.055/18.0	.054/18.0	.052/18.0	.048/18.0	.043/17.5	.040/17.0	.038/16.1	.039/15.3	.043/15.0	.047/15.0	.051/15.0	.054/15.3	.055/15.3
	21	.051/19.0	.050/19.0	.048/19.0	.044/19.0	.040/18.5	.036/18.0	.034/17.5	.036/16.5	.039/16.1	.043/16.1	.047/16.1	.049/16.1	.050/16.1
10	7	.017/13.4	.017/13.4	.019/13.4	.022/13.4	.025/10.5	.028/ 7.0	.029/ 7.0	.030/ 7.0	.030/ 7.0	.029/ 7.0	.027/ 7.0	.025/ 5.2	.025/ 5.2
	9	.029/13.4	.029/13.4	.031/13.4	.033/13.4	.035/13.4	.037/12.1	.039/ 8.1	.040/ 7.9	.041/ 7.9	.040/ 8.1	.040/ 8.1	.039/ 8.1	.039/ 8.1
	11	.043/16.1	.043/16.1	.043/16.1	.043/16.1	.043/15.7	.043/15.0	.044/13.1	.046/ 9.5	.047/ 9.5	.049/ 9.2	.050/ 9.2	.051/ 9.5	.051/ 9.5
	13	.053/17.0	.053/17.0	.051/17.0	.049/17.0	.047/16.5	.046/16.1	.046/15.0	.047/11.2	.050/10.8	.053/10.8	.055/10.8	.057/10.8	.058/10.8
	15	.057/18.0	.057/18.0	.054/18.0	.051/18.0	.048/17.5	.045/17.0	.044/15.7	.046/12.8	.049/12.1	.053/11.6	.056/11.6	.059/11.6	.060/11.6
	17	.058/19.0	.057/19.0	.054/19.0	.050/18.5	.046/18.5	.043/18.0	.042/16.5	.043/14.3	.046/13.4	.051/12.8	.055/12.8	.058/12.8	.059/12.8
	19	.055/19.6	.054/19.6	.052/19.6	.048/19.6	.04 /19.0	.040/18.5	.038/17.5	.040/15.3	.043/14.3	.047/14.0	.051/14.0	.054/14.0	.055/14.0
	21	.051/20.9	.050/20.9	.048/20.9	.044/20.3	.040/20.3	.036/19.6	.035/18.5	.036/16.5	.039/15.7	.043/15.3	.047/15.3	.050/15.3	.051/15.3
15	7	.017/17.5	.017/17.5	.019/17.5	.022/17.5	.025/17.5	.027/10.1	.029/ 6.4	.029/ 6.4	.029/ 6.4	.028/ 6.4	.026/ 6.5	.024/ 6.5	.024/ 4.8
	9	.029/19.6	.029/19.6	.031/19.6	.033/19.6	.035/17.5	.037/12.6	.039/ 7.1	.041/ 7.1	.041/ 7.1	.041/ 7.3	.041/ 7.3	.040/ 7.3	.040/ 7.3
	11	.043/20.3	.043/20.3	.043/20.3	.043/20.3	.043/20.3	.044/18.0	.045/15.7	.046/ 8.5	.048/ 8.3	.050/ 8.3	.051/ 8.3	.052/ 8.3	.053/ 8.3
	13	.053/20.3	.053/20.3	.051/20.3	.049/20.3	.047/20.3	.046/19.6	.046/18.0	.048/10.1	.050/ 9.8	.054/ 9.8	.056/ 9.8	.059/ 9.8	.059/ 9.8
	15	.057/20.9	.057/20.9	.054/20.9	.051/20.3	.048/20.3	.045/20.3	.045/18.5	.046/12.1	.049/11.2	.054/10.8	.057/10.8	.060/10.8	.061/10.8
	17	.058/21.7	.057/21.7	.054/20.9	.050/20.9	.046/20.9	.043/20.3	.042/19.6	.043/13.4	.047/12.6	.051/12.1	.055/12.1	.058/12.1	.059/12.1
	19	.055/21.7	.054/21.7	.052/21.7	.048/21.7	.043/21.7	.040/20.9	.038/19.6	.040/16.1	.043/13.7	.048/13.4	.052/13.1	.055/13.1	.056/13.1
	21	.051/22.4	.050/22.4	.047/22.4	.044/22.4	.040/22.4	.036/21.7	.035/18.5	.036/16.5	.039/15.0	.043/14.6	.047/14.3	.050/14.3	.051/14.3
20	7	.017/41.9	.017/13.4	.019/13.4	.022/13.4	.024/13.4	.027/13.4	.028/13.4	.029/ 6.3	.028/ 6.3	.027/ 6.3	.025/ 6.3	.023/ 6.3	.023/ 4.2
	9	.029/23.3	.029/19.0	.031/19.0	.033/19.0	.035/19.0	.037/19.0	.039/19.0	.041/ 6.7	.042/ 6.7	.041/ 6.8	.041/ 6.8	.040/ 6.8	.040/ 6.8
	11	.043/23.3	.043/23.3	.043/23.3	.043/23.3	.043/23.3	.044/19.0	.045/19.0	.047/ 7.1	.049/ 7.1	.051/ 7.1	.053/ 7.3	.054/ 7.3	.054/ 7.3
	13	.053/23.3	.053/23.3	.051/23.3	.049/23.3	.047/23.3	.046/23.3	.046/19.0	.048/19.0	.051/ 9.0	.055/ 9.0	.058/ 8.7	.060/ 8.7	.061/ 8.7
	15	.057/26.2	.057/26.2	.054/26.2	.051/26.2	.048/23.3	.045/23.3	.045/23.3	.046/19.0	.050/10.5	.054/10.1	.058/10.1	.061/10.1	.062/10.1
	17	.058/26.2	.057/26.2	.054/26.2	.050/26.2	.046/26.2	.043/23.3	.042/23.3	.044/11.6	.047/11.6	.052/11.2	.056/11.2	.059/11.2	.060/11.2
	19	.055/27.3	.054/27.3	.051/27.3	.047/26.2	.043/26.2	.040/23.3	.038/23.3	.040/14.6	.043/12.6	.048/12.6	.052/12.6	.055/12.6	.056/12.6
	21	.051/27.3	.050/27.3	.047/27.3	.044/27.3	.039/26.2	.036/23.3	.035/23.3	.036/15.7	.039/14.6	.044/13.7	.048/13.7	.050/13.4	.051/13.4

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

AD-A050 825 DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 13/10
RIGID BODY SHIP RESPONSES AND ASSOCIATED PERIODS FOR A SERIES O--ETC(U)
APR 75 S L BALES, A E BAITIS, W G MEYERS MIPR-Z-70099-3-30922
UNCLASSIFIED SPD-517-04 NL

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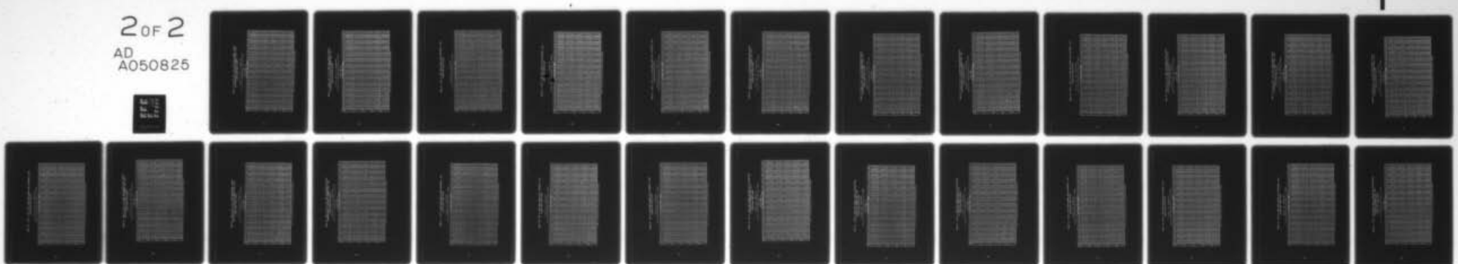
A050825



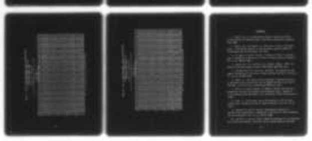


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TABLE 21 - SHIP B, GM = 6 FT, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 6 FT (MEMBRANE TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)

CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.047/ 8.3	.061/ 7.9	.092/ 7.7	.126/ 7.3	.154/ 7.1	.175/ 7.0	.184/ 7.0	.183/ 7.0	.170/ 7.0	.147/ 7.0	.117/ 7.0	.086/ 7.0	.069/ 7.1
	9	.071/ 9.5	.083/ 9.5	.112/ 9.2	.145/ 9.0	.172/ 8.7	.192/ 8.7	.200/ 8.5	.197/ 8.5	.183/ 8.7	.159/ 8.7	.128/ 9.0	.098/ 9.2	.084/ 9.5
	11	.081/10.5	.091/10.5	.115/10.1	.143/10.1	.168/ 9.8	.185/ 9.8	.192/ 9.8	.188/ 9.8	.175/ 9.8	.153/ 9.8	.126/10.1	.101/10.5	.089/10.5
	13	.079/11.6	.088/11.6	.109/11.2	.132/11.2	.153/10.8	.168/10.8	.174/10.8	.171/10.8	.160/10.8	.141/11.2	.118/11.2	.097/11.6	.088/11.6
	15	.073/12.6	.081/12.6	.098/12.6	.118/12.6	.136/12.6	.149/12.8	.154/14.3	.152/14.3	.142/14.3	.126/14.3	.107/14.6	.090/14.6	.082/14.6
	17	.066/13.4	.072/13.7	.087/13.7	.104/14.0	.119/14.3	.130/14.3	.135/14.3	.133/14.3	.125/14.3	.112/14.6	.095/14.6	.081/14.6	.075/14.6
	19	.059/13.7	.064/14.0	.076/14.0	.091/14.3	.104/14.3	.114/14.3	.118/14.3	.116/14.3	.109/14.6	.098/14.6	.084/14.6	.072/15.0	.066/15.0
	21	.052/14.0	.056/14.0	.067/14.3	.079/14.3	.091/14.3	.099/14.3	.103/14.3	.101/14.3	.095/14.6	.085/14.6	.073/14.6	.063/15.0	.059/15.0
5	7	.045/ 8.7	.060/ 8.5	.091/ 7.5	.125/ 7.3	.155/ 7.3	.176/ 7.1	.188/ 7.0	.187/ 7.0	.175/ 6.8	.153/ 6.8	.123/ 6.8	.092/ 6.8	.075/ 7.0
	9	.067/10.8	.079/10.5	.108/ 9.8	.142/ 9.2	.171/ 9.0	.192/ 8.7	.202/ 8.5	.201/ 8.5	.188/ 8.3	.165/ 8.3	.135/ 8.3	.105/ 8.3	.091/ 8.5
	11	.075/11.6	.085/11.6	.110/11.2	.139/10.8	.165/10.5	.183/10.1	.192/ 9.8	.191/ 9.5	.179/ 9.5	.158/ 9.5	.132/ 9.5	.107/ 9.5	.095/ 9.5
	13	.073/12.8	.081/12.6	.102/12.6	.127/12.1	.150/11.6	.166/11.2	.174/11.2	.173/10.8	.163/10.5	.145/10.5	.123/10.5	.102/10.5	.093/10.5
	15	.067/13.4	.074/13.4	.092/13.4	.113/13.4	.132/13.7	.147/13.7	.154/14.3	.153/14.3	.145/14.3	.130/14.3	.111/14.6	.094/14.6	.087/14.6
	17	.060/13.7	.066/14.0	.081/14.0	.100/14.0	.116/14.3	.129/14.3	.135/14.3	.135/14.3	.128/14.3	.115/14.6	.099/14.6	.085/14.6	.079/14.6
	19	.054/14.0	.059/14.0	.072/14.0	.087/14.3	.101/14.3	.112/14.3	.118/14.3	.118/14.3	.112/14.6	.101/14.6	.087/14.6	.075/14.6	.070/14.6
	21	.048/17.0	.052/14.0	.063/14.3	.076/14.3	.088/14.3	.098/14.3	.103/14.3	.102/14.6	.097/14.6	.088/14.6	.077/14.6	.066/14.6	.062/14.6
10	7	.042/ 9.8	.056/ 9.5	.088/ 7.9	.123/ 7.7	.154/ 7.3	.177/ 6.7	.189/ 6.7	.189/ 6.7	.178/ 6.4	.156/ 6.4	.127/ 6.4	.095/ 6.3	.078/ 6.4
	9	.062/12.1	.074/11.6	.104/10.5	.138/ 9.8	.168/ 8.7	.191/ 8.5	.203/ 8.1	.203/ 7.9	.192/ 7.9	.170/ 7.7	.140/ 7.7	.110/ 7.5	.096/ 7.5
	11	.068/13.7	.078/13.4	.104/12.6	.134/11.6	.161/10.5	.181/10.5	.193/ 9.8	.193/ 9.5	.183/ 9.2	.163/ 9.0	.137/ 9.0	.112/ 8.7	.100/ 8.7
	13	.066/14.0	.075/14.0	.096/13.7	.122/13.4	.145/12.6	.164/12.1	.174/11.2	.174/10.8	.166/10.5	.149/10.1	.127/ 9.8	.106/ 9.8	.097/ 9.8
	15	.061/16.1	.068/14.0	.086/14.0	.108/14.0	.129/14.0	.145/14.0	.154/14.0	.155/14.3	.148/14.3	.134/11.2	.115/10.8	.098/10.8	.090/10.8
	17	.055/16.5	.062/16.5	.077/14.0	.095/14.3	.113/14.3	.127/14.3	.135/14.3	.136/14.3	.130/14.3	.118/14.6	.103/14.6	.088/14.6	.082/14.6
	19	.050/17.0	.055/17.0	.068/14.3	.084/14.3	.099/14.3	.111/14.3	.118/14.3	.119/14.3	.114/14.6	.104/14.6	.091/14.6	.079/14.6	.073/14.6
	21	.044/18.5	.048/18.5	.059/18.0	.073/14.3	.086/14.3	.096/14.3	.102/14.3	.103/14.6	.099/14.6	.091/14.6	.079/14.6	.069/14.6	.065/14.6
15	7	.039/14.3	.054/14.3	.086/14.3	.121/ 8.5	.153/ 6.3	.177/ 6.3	.190/ 6.3	.191/ 6.3	.180/ 6.3	.159/ 5.7	.129/ 5.7	.097/ 5.7	.080/ 5.7
	9	.057/14.3	.069/14.3	.099/14.3	.134/ 9.2	.166/ 8.7	.190/ 8.5	.204/ 8.3	.205/ 7.3	.195/ 7.1	.173/ 7.1	.144/ 7.0	.114/ 7.0	.100/ 7.0
	11	.062/17.5	.072/14.3	.098/14.3	.129/12.1	.158/11.6	.180/ 9.5	.193/ 9.2	.195/ 9.0	.186/ 8.7	.167/ 8.5	.142/ 8.3	.117/ 8.1	.105/ 8.1
	13	.060/17.5	.069/17.5	.091/14.3	.117/14.3	.142/14.3	.162/12.1	.173/11.6	.176/10.1	.168/ 9.8	.153/ 9.5	.131/ 9.2	.111/ 9.2	.101/ 9.0
	15	.056/17.5	.063/17.5	.081/14.3	.104/14.3	.126/14.3	.143/14.3	.153/14.3	.156/14.3	.150/11.6	.137/10.8	.119/10.5	.102/10.1	.094/ 9.8
	17	.050/19.6	.057/17.5	.072/17.5	.092/14.3	.110/14.3	.125/14.3	.135/14.3	.137/14.3	.132/14.3	.121/14.3	.106/14.3	.091/14.6	.085/14.6
	19	.045/19.6	.050/19.6	.064/19.6	.080/14.3	.097/14.3	.110/14.3	.118/14.3	.120/14.3	.116/14.3	.106/14.6	.093/14.6	.081/14.6	.076/14.6
	21	.040/19.6	.045/19.6	.056/19.6	.070/19.6	.084/14.3	.096/14.3	.103/14.3	.104/14.3	.101/14.6	.093/14.6	.082/14.6	.072/14.6	.067/14.6
20	7	.033/13.4	.049/13.4	.082/13.4	.118/13.4	.151/13.4	.175/ 6.3	.189/ 5.7	.191/ 5.7	.181/ 5.7	.160/ 5.7	.130/ 5.7	.097/ 5.7	.080/ 5.2
	9	.047/19.0	.060/19.0	.092/13.4	.128/13.4	.162/13.4	.187/ 7.1	.202/ 7.0	.206/ 7.0	.196/ 7.0	.176/ 6.8	.147/ 6.7	.118/ 6.5	.103/ 6.4
	11	.051/19.0	.063/19.0	.090/19.0	.122/13.4	.153/13.4	.177/ 9.8	.191/ 9.2	.195/ 9.0	.188/ 8.5	.170/ 7.9	.145/ 7.5	.120/ 7.3	.109/ 7.3
	13	.050/19.0	.060/19.0	.083/19.0	.111/13.4	.138/13.4	.159/13.4	.172/10.5	.176/ 9.8	.170/ 9.5	.156/ 9.2	.135/ 9.0	.114/ 8.7	.105/ 8.7
	15	.047/19.0	.055/19.0	.075/19.0	.099/19.0	.122/14.0	.141/14.0	.153/14.0	.156/14.0	.152/10.8	.139/10.1	.122/ 9.8	.105/ 9.5	.097/ 9.2
	17	.044/23.3	.050/19.0	.067/19.0	.087/19.0	.107/14.3	.123/14.3	.134/14.3	.138/14.3	.134/14.3	.123/14.3	.109/14.3	.094/10.5	.088/10.5
	19	.039/23.3	.045/23.3	.059/19.0	.077/19.0	.094/14.3	.108/14.3	.117/14.3	.121/14.3	.117/14.3	.108/14.3	.096/14.6	.084/14.6	.079/14.6
	21	.035/23.3	.040/23.3	.052/23.3	.067/19.0	.082/19.0	.094/14.3	.102/14.3	.105/14.3	.103/14.3	.095/14.6	.084/14.6	.074/14.6	.070/14.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 22 - SHIP B, GM = 6 FT, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP B, GM = 6 FT (MEMBRANE TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.203/ 7.7	.219/ 7.7	.254/ 7.7	.292/ 7.7	.323/ 7.7	.342/ 7.9	.346/ 7.9	.333/ 7.9	.306/ 7.9	.269/ 7.9	.229/ 7.9	.199/ 7.9	.188/ 7.9
	9	.275/ 9.5	.292/ 8.5	.332/ 8.5	.375/ 8.5	.412/ 8.5	.435/ 8.5	.441/ 8.5	.428/ 8.5	.398/ 8.5	.357/ 8.5	.313/ 8.5	.280/ 9.0	.268/ 9.2
	11	.287/10.5	.299/10.1	.329/ 9.8	.363/ 8.5	.392/ 8.5	.411/ 8.5	.416/ 8.5	.406/ 8.5	.383/ 8.7	.351/ 9.0	.318/ 9.8	.294/10.1	.285/10.1
	13	.269/10.8	.277/10.8	.297/10.8	.321/ 9.8	.342/ 9.0	.356/ 8.7	.360/ 8.7	.353/ 9.0	.336/ 9.0	.314/ 9.8	.291/10.5	.275/10.8	.269/10.8
	15	.240/11.6	.246/11.6	.260/11.2	.276/10.8	.291/ 9.2	.301/ 9.0	.304/ 9.0	.299/ 9.0	.287/ 9.2	.272/10.5	.256/11.2	.245/11.2	.241/11.6
	17	.211/12.1	.214/12.1	.224/11.6	.236/11.2	.247/ 9.2	.254/ 9.0	.256/ 9.0	.253/ 9.2	.244/ 9.5	.233/10.8	.222/11.6	.214/11.6	.211/12.1
	19	.183/12.6	.186/12.6	.193/12.1	.202/11.6	.210/ 9.8	.215/ 9.2	.217/ 9.2	.214/ 9.2	.208/ 9.8	.200/11.6	.192/12.1	.186/12.1	.184/12.6
	21	.159/12.8	.161/12.8	.167/12.6	.173/12.1	.180/10.8	.184/ 9.2	.185/ 9.2	.183/ 9.2	.178/10.5	.172/12.1	.165/12.6	.161/13.1	.159/13.4
5	7	.170/ 8.3	.191/ 8.3	.235/ 8.3	.279/ 8.1	.315/ 8.1	.337/ 8.1	.342/ 8.1	.330/ 7.9	.308/ 7.9	.265/ 7.9	.224/ 7.9	.194/ 7.9	.184/ 7.9
	9	.202/ 8.7	.225/ 8.5	.275/ 8.5	.330/ 8.5	.379/ 8.5	.416/ 8.3	.437/ 8.3	.440/ 8.3	.426/ 8.5	.399/ 8.5	.369/ 8.5	.345/ 8.5	.337/ 8.5
	11	.206/12.6	.222/12.1	.262/ 8.7	.309/ 8.7	.354/ 8.7	.392/ 8.7	.418/ 8.7	.432/ 8.7	.432/ 8.7	.421/ 8.7	.407/ 9.0	.395/ 9.0	.391/ 9.0
	13	.193/13.1	.205/13.1	.234/12.8	.269/ 8.7	.306/ 8.7	.339/ 8.7	.365/ 8.7	.381/ 8.7	.388/ 9.0	.387/ 9.0	.382/ 9.2	.378/ 9.2	.376/ 9.2
	15	.175/13.7	.183/13.7	.204/13.4	.231/12.8	.260/ 8.7	.287/ 8.7	.309/ 8.7	.326/ 9.0	.335/ 9.0	.338/ 9.2	.338/ 9.5	.337/ 9.5	.337/ 9.5
	17	.155/14.3	.161/14.3	.177/14.0	.197/13.4	.220/ 8.7	.242/ 8.7	.261/ 9.0	.276/ 9.0	.285/ 9.2	.290/ 9.2	.292/ 9.5	.293/ 9.5	.293/ 9.8
	19	.136/15.0	.141/15.0	.153/14.6	.169/14.0	.187/ 8.7	.205/ 8.7	.222/ 9.0	.234/ 9.0	.243/ 9.2	.249/ 9.5	.251/ 9.5	.253/ 9.8	.253/ 9.8
	21	.119/15.3	.123/15.3	.132/15.3	.145/15.0	.160/14.0	.175/ 8.7	.189/ 9.0	.200/ 9.0	.208/ 9.2	.213/ 9.5	.216/ 9.8	.218/10.1	.218/10.1
10	7	.116/ 9.8	.146/ 7.9	.202/ 7.9	.255/ 7.9	.296/ 7.9	.321/ 7.9	.329/ 7.9	.319/ 7.9	.292/ 7.7	.253/ 7.7	.211/ 7.5	.178/ 7.3	.167/ 7.3
	9	.138/ 9.8	.166/ 9.8	.224/ 8.5	.287/ 8.3	.345/ 8.3	.393/ 8.3	.426/ 8.3	.442/ 8.3	.441/ 8.1	.427/ 8.1	.406/ 8.1	.389/ 8.1	.383/ 8.1
	11	.142/15.3	.162/15.3	.209/ 8.7	.265/ 8.5	.323/ 8.5	.377/ 8.5	.424/ 8.5	.458/ 8.5	.480/ 8.5	.489/ 8.5	.491/ 8.5	.491/ 8.5	.490/ 8.5
	13	.136/15.7	.150/15.7	.185/15.3	.230/ 8.7	.280/ 8.5	.331/ 8.5	.377/ 8.5	.417/ 8.5	.446/ 8.5	.467/ 8.5	.479/ 8.5	.486/ 8.5	.489/ 8.5
	15	.125/16.5	.136/16.1	.162/16.1	.197/ 8.7	.238/ 8.7	.282/ 8.7	.324/ 8.7	.361/ 8.7	.391/ 8.7	.414/ 8.7	.430/ 8.7	.439/ 8.7	.442/ 8.7
	17	.113/17.0	.121/17.0	.141/16.5	.169/16.1	.202/ 8.7	.239/ 8.7	.275/ 8.7	.308/ 8.7	.336/ 8.7	.358/ 8.7	.373/ 9.0	.383/ 9.0	.386/ 9.0
	19	.101/17.5	.106/17.5	.122/17.0	.145/16.5	.172/ 8.7	.203/ 8.7	.233/ 8.7	.262/ 8.7	.287/ 9.0	.306/ 9.0	.321/ 9.0	.330/ 9.0	.333/ 9.0
	21	.089/18.5	.094/18.0	.106/18.0	.125/17.0	.147/ 8.7	.173/ 8.7	.199/ 8.7	.224/ 8.7	.245/ 9.0	.263/ 9.0	.276/ 9.0	.284/ 9.0	.286/ 9.0
15	7	.100/ 8.3	.135/ 8.3	.195/ 8.3	.249/ 8.1	.291/ 8.1	.317/ 7.9	.324/ 7.9	.313/ 7.7	.285/ 7.7	.244/ 7.7	.197/ 7.1	.162/ 7.0	.151/ 7.0
	9	.106/ 8.5	.137/ 8.5	.198/ 8.5	.264/ 8.5	.326/ 8.3	.379/ 8.3	.419/ 8.1	.441/ 7.9	.446/ 7.9	.437/ 7.9	.419/ 7.7	.404/ 7.7	.398/ 7.7
	11	.104/19.6	.128/19.6	.178/ 8.5	.240/ 8.5	.307/ 8.5	.374/ 8.3	.434/ 8.3	.483/ 8.3	.519/ 8.3	.541/ 8.1	.553/ 8.1	.559/ 8.1	.561/ 8.1
	13	.099/20.3	.116/20.3	.155/ 8.5	.208/ 8.5	.268/ 8.5	.333/ 8.5	.396/ 8.5	.454/ 8.3	.501/ 8.3	.538/ 8.3	.564/ 8.3	.579/ 8.3	.584/ 8.3
	15	.092/20.3	.104/20.3	.135/20.3	.177/ 8.5	.229/ 8.5	.286/ 8.5	.344/ 8.5	.399/ 8.5	.448/ 8.5	.487/ 8.5	.515/ 8.5	.533/ 8.5	.539/ 8.5
	17	.084/20.3	.093/20.3	.117/20.3	.151/ 8.5	.194/ 8.5	.243/ 8.5	.294/ 8.5	.343/ 8.5	.388/ 8.5	.424/ 8.5	.452/ 8.5	.469/ 8.5	.475/ 8.5
	19	.076/20.3	.083/20.3	.102/20.3	.130/20.3	.166/ 8.5	.207/ 8.5	.251/ 8.5	.294/ 8.5	.332/ 8.5	.365/ 8.5	.390/ 8.5	.405/ 8.5	.411/ 8.5
	21	.067/20.9	.073/20.9	.088/20.9	.112/20.3	.142/ 8.5	.177/ 8.5	.214/ 8.5	.251/ 8.5	.285/ 8.5	.314/ 8.5	.335/ 8.5	.349/ 8.5	.354/ 8.5
20	7	.084/ 8.5	.117/ 8.5	.172/ 8.5	.223/ 8.5	.263/ 8.5	.289/ 8.5	.297/ 8.5	.289/ 8.5	.264/ 8.3	.226/ 7.0	.183/ 6.8	.148/ 6.7	.135/ 6.7
	9	.083/13.7	.113/ 8.7	.172/ 8.5	.237/ 8.5	.303/ 8.5	.360/ 8.3	.404/ 8.3	.431/ 7.7	.440/ 7.7	.433/ 7.5	.416/ 7.3	.400/ 7.3	.393/ 7.3
	11	.078/19.0	.102/19.0	.153/ 9.0	.219/ 8.5	.294/ 8.5	.370/ 8.3	.441/ 8.1	.501/ 7.9	.546/ 7.9	.577/ 7.7	.594/ 7.7	.602/ 7.7	.605/ 7.7
	13	.073/23.3	.091/23.3	.133/ 9.0	.191/ 8.5	.261/ 8.5	.338/ 8.3	.416/ 8.3	.487/ 8.1	.549/ 8.1	.597/ 8.1	.632/ 8.1	.652/ 8.1	.659/ 8.1
	15	.068/23.3	.081/23.3	.115/23.3	.163/ 8.7	.224/ 8.5	.294/ 8.3	.367/ 8.3	.437/ 8.3	.500/ 8.3	.552/ 8.3	.590/ 8.3	.615/ 8.1	.623/ 8.1
	17	.063/26.2	.073/23.3	.099/23.3	.139/ 9.0	.191/ 8.5	.252/ 8.5	.316/ 8.3	.379/ 8.3	.437/ 8.3	.486/ 8.3	.523/ 8.3	.547/ 8.3	.555/ 8.3
	19	.057/26.2	.065/26.2	.086/23.3	.119/ 9.0	.163/ 8.5	.215/ 8.5	.270/ 8.3	.326/ 8.3	.377/ 8.3	.421/ 8.3	.455/ 8.3	.476/ 8.3	.483/ 8.3
	21	.051/27.3	.058/27.3	.075/27.3	.103/19.0	.139/ 8.5	.183/ 8.5	.231/ 8.3	.279/ 8.3	.324/ 8.3	.363/ 8.3	.392/ 8.3	.411/ 8.3	.418/ 8.3

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 23 - SHIP C, ROOT MEAN SQUARE HEAVE RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C (SPHERICAL TANKS)

RMS HEAVE IN FEET/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.024/ 8.7	.028/ 8.7	.037/ 8.7	.047/ 8.7	.055/ 8.7	.060/ 8.7	.062/ 8.7	.060/ 8.7	.055/ 8.7	.047/ 8.7	.038/ 8.7	.029/ 8.7	.025/ 8.7
	9	.052/ 9.5	.061/ 9.5	.079/ 9.5	.099/ 9.5	.116/ 9.5	.127/ 9.8	.130/ 9.8	.127/ 9.8	.116/ 9.5	.100/ 9.5	.080/ 9.5	.061/ 9.5	.053/ 9.5
	11	.080/13.4	.089/13.1	.110/12.6	.134/11.6	.155/11.2	.168/11.2	.173/11.2	.169/11.2	.156/11.2	.136/11.6	.112/12.6	.090/13.1	.081/13.1
	13	.111/14.6	.119/14.6	.138/14.3	.160/14.0	.180/13.7	.193/13.4	.198/13.4	.193/13.4	.181/13.7	.161/14.0	.139/14.3	.120/14.6	.112/14.6
	15	.141/16.5	.147/16.1	.162/16.1	.180/15.7	.197/15.7	.209/15.3	.213/15.3	.209/15.7	.198/15.7	.181/15.7	.163/16.1	.148/16.5	.142/16.5
	17	.165/18.0	.169/18.0	.181/18.0	.195/17.5	.209/17.5	.219/17.5	.223/17.5	.219/17.5	.210/17.5	.197/17.5	.182/18.0	.171/18.0	.166/18.0
	19	.183/19.6	.186/19.6	.195/19.6	.207/19.6	.218/19.0	.226/19.0	.229/19.0	.226/19.0	.219/19.0	.208/19.6	.197/19.6	.188/19.6	.185/19.6
	21	.198/21.7	.201/21.7	.208/21.7	.217/21.7	.226/21.7	.232/21.7	.235/20.9	.233/20.9	.227/21.7	.218/21.7	.209/21.7	.202/21.7	.200/21.7
5	7	.026/10.5	.030/ 9.2	.039/ 9.0	.048/ 9.0	.056/ 9.0	.061/ 8.7	.062/ 8.7	.059/ 8.7	.053/ 8.7	.045/ 8.7	.034/ 8.7	.023/ 8.3	.018/ 8.3
	9	.048/11.2	.057/10.8	.077/10.5	.098/10.1	.115/ 9.8	.126/ 9.8	.131/ 9.8	.127/ 9.8	.116/ 9.8	.100/ 9.5	.079/ 9.5	.059/ 9.8	.050/ 9.8
	11	.074/15.0	.084/14.6	.106/11.6	.132/11.6	.153/11.2	.168/11.2	.174/10.8	.171/10.8	.158/10.8	.139/11.2	.115/11.2	.094/11.6	.085/11.6
	13	.106/16.5	.114/16.1	.133/15.7	.157/15.0	.177/14.3	.192/13.7	.199/13.1	.196/13.1	.184/12.8	.166/13.1	.145/13.1	.127/13.4	.119/13.4
	15	.136/18.0	.142/18.0	.157/17.5	.177/17.0	.195/16.5	.208/15.7	.214/15.3	.212/15.0	.202/15.0	.187/15.0	.169/15.0	.155/15.0	.149/15.0
	17	.160/19.6	.165/19.6	.177/19.0	.192/19.0	.207/18.5	.218/18.0	.223/17.5	.222/17.0	.214/17.0	.202/17.0	.188/16.5	.177/17.0	.173/17.0
	19	.179/21.7	.182/20.9	.192/20.9	.204/20.9	.216/20.3	.225/19.6	.229/19.0	.228/19.0	.222/18.5	.213/18.5	.202/18.5	.194/18.5	.190/18.5
	21	.195/23.3	.197/23.3	.204/22.4	.214/22.4	.224/21.7	.231/21.7	.235/20.9	.234/20.9	.230/20.3	.222/20.3	.214/20.3	.207/20.3	.205/20.3
10	7	.023/12.8	.028/ 9.0	.038/ 9.0	.048/ 9.0	.056/ 9.0	.061/ 8.7	.062/ 8.7	.059/ 8.7	.052/ 8.7	.043/ 8.7	.032/ 8.7	.020/ 8.5	.014/ 8.5
	9	.043/14.0	.053/14.0	.074/10.1	.096/ 9.8	.114/ 9.8	.126/ 9.5	.130/ 9.5	.127/ 9.5	.117/ 9.5	.100/ 9.5	.079/ 9.5	.059/ 9.5	.049/ 9.5
	11	.070/17.0	.080/17.0	.103/14.3	.129/11.6	.152/11.2	.168/10.8	.175/10.5	.173/10.5	.162/10.5	.144/10.5	.122/10.5	.101/10.5	.093/10.5
	13	.102/18.5	.110/18.5	.130/18.0	.154/17.0	.176/14.3	.192/13.7	.201/12.8	.200/12.6	.190/12.1	.174/12.1	.155/12.1	.138/12.1	.131/12.1
	15	.132/19.6	.138/19.6	.154/19.6	.174/18.5	.193/17.5	.208/16.1	.215/15.3	.215/14.6	.208/14.3	.195/14.0	.179/13.7	.166/13.7	.161/13.7
	17	.157/21.7	.161/21.7	.173/20.9	.189/20.3	.205/19.6	.218/18.5	.225/17.5	.225/17.0	.219/16.1	.209/16.1	.197/15.7	.187/15.7	.183/15.7
	19	.176/23.3	.179/23.3	.189/22.4	.201/21.7	.214/21.7	.225/20.3	.231/19.6	.231/18.5	.227/18.0	.219/18.0	.209/17.5	.202/17.5	.199/17.5
	21	.192/25.1	.194/24.2	.202/24.2	.212/23.3	.222/23.3	.231/22.4	.236/21.7	.237/20.9	.234/20.3	.227/19.6	.220/19.0	.214/19.0	.212/19.0
15	7	.019/10.5	.025/10.5	.037/ 9.5	.047/ 9.2	.055/ 9.2	.060/ 9.0	.061/ 8.7	.058/ 8.7	.052/ 8.7	.042/ 8.7	.030/ 8.5	.018/ 8.3	.012/ 8.3
	9	.039/14.3	.050/10.5	.072/10.5	.094/10.1	.112/ 9.8	.125/ 9.5	.130/ 9.5	.127/ 9.2	.117/ 9.2	.100/ 9.2	.079/ 9.0	.059/ 9.0	.050/ 9.0
	11	.067/20.9	.077/20.9	.101/14.3	.127/11.2	.151/10.8	.168/10.5	.177/10.1	.176/10.1	.167/ 9.8	.150/ 9.8	.130/ 9.5	.111/ 9.5	.103/ 9.5
	13	.099/21.7	.107/21.7	.127/21.7	.152/20.9	.175/14.3	.193/13.4	.203/12.1	.205/11.6	.198/11.2	.185/10.8	.168/10.8	.153/10.5	.148/10.5
	15	.129/22.4	.135/22.4	.151/22.4	.172/21.7	.192/17.5	.208/16.5	.218/15.0	.221/14.3	.216/13.4	.206/13.1	.193/12.6	.182/12.6	.178/12.6
	17	.154/24.2	.158/23.3	.171/23.3	.187/22.4	.204/21.7	.218/19.0	.227/17.5	.230/16.5	.227/15.7	.219/15.3	.209/14.6	.201/14.3	.198/14.3
	19	.173/25.1	.176/25.1	.186/25.1	.199/24.2	.213/22.4	.225/21.7	.233/19.6	.236/18.5	.233/17.5	.227/17.0	.220/16.5	.214/16.5	.211/16.1
	21	.189/26.2	.192/26.2	.199/26.2	.210/25.1	.221/23.3	.231/22.4	.238/20.9	.240/20.3	.239/19.6	.234/19.0	.229/18.5	.224/18.0	.222/18.0
20	7	.019/10.1	.026/10.1	.038/10.1	.049/ 9.8	.058/ 8.7	.063/ 8.7	.063/ 8.7	.060/ 8.5	.053/ 8.5	.042/ 8.5	.030/ 8.5	.017/ 8.3	.010/ 8.1
	9	.038/19.0	.049/19.0	.071/10.8	.094/10.1	.112/ 9.5	.125/ 9.5	.129/ 9.0	.127/ 9.0	.116/ 9.0	.099/ 9.0	.079/ 8.7	.058/ 8.7	.049/ 8.7
	11	.065/23.3	.076/23.3	.099/23.3	.126/11.6	.150/10.8	.168/10.1	.178/ 9.8	.179/ 9.5	.171/ 9.5	.156/ 9.2	.137/ 9.2	.119/ 9.0	.112/ 9.0
	13	.097/26.2	.105/26.2	.125/26.2	.150/23.3	.175/15.7	.194/12.6	.206/11.6	.210/10.5	.206/10.1	.196/ 9.8	.182/ 9.8	.169/ 9.5	.164/ 9.5
	15	.127/27.3	.133/27.3	.149/27.3	.170/26.2	.191/20.3	.210/16.1	.222/15.0	.227/13.4	.226/12.6	.219/11.6	.209/11.2	.200/10.5	.197/10.5
	17	.151/27.3	.156/27.3	.168/27.3	.185/27.3	.203/23.3	.219/19.6	.231/17.0	.236/16.1	.236/15.0	.231/14.0	.224/13.4	.218/13.1	.216/13.1
	19	.171/27.3	.174/27.3	.184/27.3	.198/27.3	.212/26.2	.226/20.9	.235/19.6	.241/18.0	.241/17.0	.238/16.1	.233/15.7	.228/15.3	.227/15.3
	21	.187/28.6	.190/28.6	.197/28.6	.209/28.6	.221/26.2	.232/23.3	.240/20.9	.245/19.6	.245/19.0	.243/18.0	.240/17.5	.236/17.0	.235/17.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 24 - SHIP C, ROOT MEAN SQUARE PITCH RESPONSES, UNIT SIGNI[illegible]CANT WAVE HEIGHT

LNG [illegible]ERIES: [illegible]P C (SPHERICAL TANKS)

RMS PITCH IN DEGR[illegible]ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.012/ 8.5	.013/ 8.5	.014/ 8.5	.016/ 8.5	.017/ 8.5	.018/ 8.5	.018/ 8.5	.018/ 8.5	.016/ 8.5	.015/ 8.5	.013/ 8.5	.012/ 8.5	.011/ 8.5
	9	.028/10.8	.028/10.8	.030/10.5	.031/10.1	.033/ 9.5	.034/ 9.5	.034/ 9.5	.033/ 9.5	.032/ 9.8	.030/10.1	.028/10.5	.027/10.8	.026/10.8
	11	.041/11.6	.041/11.6	.041/11.6	.041/11.6	.041/11.2	.041/10.8	.041/10.5	.041/10.8	.040/11.2	.040/11.6	.040/11.6	.039/11.6	.039/11.6
	13	.048/12.8	.047/12.8	.046/12.6	.045/12.6	.044/12.1	.043/11.6	.042/11.6	.042/11.6	.043/12.1	.044/12.6	.045/12.8	.046/12.8	.047/12.8
	15	.049/14.0	.049/13.7	.047/13.7	.045/13.4	.043/13.4	.041/12.8	.040/12.6	.040/12.8	.042/13.4	.044/13.4	.047/13.7	.048/13.7	.049/14.0
	17	.048/14.6	.048/14.6	.046/14.6	.043/14.6	.040/14.3	.038/14.0	.037/13.7	.038/14.0	.040/14.3	.043/14.6	.045/14.6	.047/15.0	.048/15.0
	19	.046/15.7	.045/15.7	.043/15.7	.040/15.7	.037/15.3	.034/15.0	.033/14.6	.034/15.3	.037/15.7	.040/15.7	.043/15.7	.045/16.1	.045/16.1
	21	.042/17.0	.042/17.0	.040/17.0	.037/16.5	.034/16.5	.031/16.1	.030/16.1	.031/16.1	.033/16.5	.037/17.0	.039/17.0	.041/17.0	.042/17.0
5	7	.015/ 9.5	.015/ 9.5	.017/ 9.5	.018/ 9.5	.019/ 9.2	.019/ 8.7	.019/ 8.5	.017/ 8.5	.015/ 8.5	.013/ 8.5	.011/ 8.5	.009/ 8.5	.008/ 8.7
	9	.026/12.6	.027/12.6	.029/10.8	.031/ 9.8	.032/ 9.8	.033/ 9.5	.034/ 9.5	.033/ 9.5	.031/ 9.5	.029/ 9.5	.027/ 9.5	.026/ 9.8	.025/ 9.8
	11	.037/13.7	.037/13.7	.038/13.4	.039/13.1	.039/12.6	.040/10.8	.041/10.5	.041/10.1	.041/10.1	.041/10.5	.041/10.5	.042/10.5	.042/10.5
	13	.043/14.6	.043/14.6	.043/14.6	.042/14.3	.041/14.0	.041/13.1	.042/11.6	.043/11.2	.045/11.2	.047/11.2	.048/11.2	.050/11.6	.050/11.6
	15	.045/15.7	.045/15.7	.044/15.3	.042/15.3	.040/15.0	.039/14.3	.040/12.8	.041/12.1	.044/12.1	.047/12.1	.050/12.1	.052/12.1	.053/12.6
	17	.045/16.5	.044/16.5	.043/16.5	.040/16.5	.038/16.1	.037/15.3	.037/14.0	.039/13.1	.042/12.8	.045/13.1	.048/13.1	.051/13.1	.051/13.1
	19	.043/17.5	.042/17.5	.040/17.5	.038/17.5	.035/17.0	.033/16.1	.033/15.0	.035/14.0	.038/14.0	.042/14.0	.045/14.0	.048/14.3	.048/14.3
	21	.040/18.5	.039/18.5	.037/18.5	.035/18.5	.032/18.0	.030/17.5	.030/16.1	.032/15.3	.035/15.3	.038/15.3	.042/15.3	.044/15.3	.045/15.3
10	7	.013/12.8	.014/12.8	.016/10.1	.018/10.1	.019/10.1	.020/ 8.7	.019/ 8.5	.017/ 8.5	.015/ 8.3	.012/ 8.3	.009/ 8.1	.007/ 8.1	.006/ 8.1
	9	.023/13.4	.024/13.4	.026/13.4	.029/10.8	.031/10.5	.032/10.1	.033/ 9.0	.032/ 9.0	.030/ 9.0	.028/ 9.0	.026/ 9.0	.024/ 9.0	.024/ 9.0
	11	.033/16.1	.034/16.1	.035/16.1	.036/15.7	.037/15.3	.039/10.5	.040/ 9.8	.041/ 9.5	.041/ 9.5	.042/ 9.5	.042/ 9.8	.042/ 9.8	.042/ 9.8
	13	.039/17.0	.039/17.0	.039/17.0	.039/16.5	.039/16.5	.040/15.3	.041/10.5	.043/10.5	.046/10.1	.048/10.5	.050/10.5	.052/10.5	.052/10.5
	15	.042/18.0	.042/18.0	.041/18.0	.039/17.5	.038/17.5	.038/16.5	.040/11.6	.042/11.2	.046/11.2	.049/11.2	.053/11.2	.055/11.2	.055/11.2
	17	.042/18.5	.041/18.5	.040/18.5	.038/18.5	.036/18.0	.036/17.5	.037/15.0	.039/12.1	.043/12.1	.047/12.1	.051/12.1	.053/12.1	.054/12.1
	19	.040/19.6	.039/19.6	.038/19.6	.036/19.0	.034/19.0	.033/18.0	.033/16.1	.036/13.1	.040/12.6	.044/12.6	.048/12.6	.050/12.6	.051/12.8
	21	.037/20.9	.037/20.9	.035/20.3	.033/20.3	.031/19.6	.029/19.0	.030/17.0	.032/14.6	.036/13.7	.040/13.4	.044/13.7	.046/13.7	.047/13.7
15	7	.011/17.5	.012/17.5	.015/11.6	.018/ 8.7	.020/ 8.7	.020/ 8.5	.020/ 8.5	.018/ 8.5	.015/ 8.5	.012/ 8.3	.008/ 8.3	.006/ 7.9	.005/ 7.9
	9	.020/19.6	.022/19.6	.024/19.6	.027/12.6	.030/12.6	.031/ 9.0	.032/ 8.7	.031/ 8.7	.029/ 8.5	.026/ 8.5	.024/ 8.5	.022/ 8.5	.021/ 8.5
	11	.030/20.3	.031/20.3	.032/20.3	.034/20.3	.036/20.3	.038/ 9.2	.039/ 9.2	.040/ 9.0	.041/ 9.0	.041/ 9.0	.042/ 9.0	.042/ 9.0	.042/ 9.0
	13	.037/20.3	.037/20.3	.037/20.3	.037/20.3	.038/20.3	.039/18.0	.041/ 9.5	.044/ 9.5	.047/ 9.5	.049/ 9.5	.052/ 9.5	.053/ 9.5	.054/ 9.5
	15	.039/20.9	.039/20.9	.038/20.9	.037/20.9	.037/20.3	.038/20.3	.040/ 9.8	.043/ 9.8	.047/ 9.8	.051/10.1	.054/10.1	.057/10.1	.057/10.1
	17	.039/21.7	.039/21.7	.038/21.7	.036/20.9	.035/20.9	.035/20.3	.037/12.1	.040/10.5	.045/10.8	.049/10.8	.053/10.8	.056/10.8	.057/10.8
	19	.038/22.4	.038/22.4	.036/21.7	.034/21.7	.032/21.7	.032/20.9	.033/19.6	.037/12.1	.041/11.6	.046/11.6	.050/11.6	.052/11.6	.053/11.6
	21	.036/22.4	.035/22.4	.034/22.4	.032/22.4	.030/22.4	.029/21.7	.030/19.6	.033/12.8	.037/12.6	.042/12.6	.046/12.6	.048/12.6	.049/12.6
20	7	.010/13.7	.011/13.7	.015/13.7	.017/13.7	.019/ 9.2	.020/ 9.2	.019/ 9.2	.018/ 9.2	.015/ 9.2	.011/ 9.2	.007/ 7.9	.005/ 7.7	.004/ 7.7
	9	.019/19.0	.020/19.0	.023/19.0	.026/19.0	.029/19.0	.030/14.3	.031/ 9.0	.030/ 8.7	.028/ 8.5	.025/ 8.5	.022/ 8.3	.020/ 8.3	.019/ 8.3
	11	.028/23.3	.029/23.3	.030/23.3	.032/23.3	.035/19.0	.037/19.0	.039/ 9.0	.040/ 9.0	.041/ 8.7	.041/ 8.7	.041/ 8.7	.040/ 8.7	.040/ 8.7
	13	.035/23.3	.035/23.3	.035/23.3	.035/23.3	.037/23.3	.038/23.3	.041/ 9.0	.044/ 9.0	.047/ 9.0	.050/ 9.0	.052/ 9.0	.054/ 9.0	.054/ 9.0
	15	.037/26.2	.037/26.2	.037/26.2	.036/26.2	.036/23.3	.037/23.3	.040/ 9.2	.044/ 9.2	.048/ 9.2	.052/ 9.2	.056/ 9.2	.058/ 9.2	.059/ 9.2
	17	.038/26.2	.037/26.2	.036/26.2	.035/26.2	.034/23.3	.035/23.3	.037/23.3	.041/ 9.5	.046/ 9.5	.051/ 9.5	.055/ 9.8	.057/ 9.8	.058/ 9.8
	19	.037/27.3	.036/27.3	.035/27.3	.033/26.2	.032/26.2	.032/23.3	.034/23.3	.038/ 9.8	.042/ 9.8	.047/10.1	.051/10.1	.054/10.1	.055/10.5
	21	.035/27.3	.034/27.3	.033/27.3	.031/27.3	.029/26.2	.029/26.2	.030/23.3	.034/11.2	.039/11.2	.043/11.2	.047/11.6	.050/11.6	.051/11.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 25 - SHIP C, GM = 2 FT, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 2 FT (SPHERICAL TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.006/ 7.9	.007/ 7.9	.008/ 7.9	.010/ 7.9	.012/ 7.9	.013/ 7.7	.013/ 7.7	.013/ 7.9	.012/ 7.9	.010/ 7.9	.008/ 7.9	.007/ 7.9	.006/ 7.9
	9	.007/ 8.5	.009/ 8.7	.011/ 8.7	.014/ 9.5	.017/ 9.5	.018/ 9.5	.019/ 9.5	.018/ 9.5	.017/ 9.5	.014/ 9.5	.011/ 8.7	.009/ 8.7	.008/ 8.7
	11	.008/12.6	.010/12.1	.013/11.6	.017/11.6	.020/11.6	.022/11.6	.022/11.6	.022/11.6	.020/11.6	.017/11.6	.013/12.1	.010/12.1	.008/12.6
	13	.009/14.3	.011/14.3	.015/13.7	.019/13.4	.022/13.1	.024/13.1	.025/13.1	.024/13.1	.022/13.1	.019/13.4	.015/13.4	.011/14.0	.010/14.0
	15	.011/15.7	.012/15.7	.016/15.3	.020/15.3	.024/15.3	.026/15.3	.027/15.3	.026/15.7	.024/15.7	.021/16.1	.017/16.5	.013/17.0	.011/17.0
	17	.012/18.0	.013/18.0	.017/17.5	.021/17.5	.025/17.5	.027/17.5	.028/17.5	.027/17.5	.025/18.0	.022/18.0	.018/18.0	.014/18.5	.013/18.5
	19	.013/20.9	.014/20.9	.018/19.0	.022/19.0	.026/19.0	.028/19.0	.029/19.0	.028/19.0	.026/19.6	.023/19.6	.019/20.3	.016/20.3	.014/20.3
	21	.013/22.4	.015/22.4	.018/22.4	.022/22.4	.026/21.7	.028/21.7	.029/21.7	.028/21.7	.026/21.7	.023/21.7	.020/21.7	.016/21.7	.015/21.7
5	7	.008/ 9.5	.009/ 9.5	.010/ 9.2	.011/ 9.2	.013/ 7.9	.013/ 7.9	.013/ 7.9	.013/ 7.7	.011/ 7.7	.010/ 7.5	.007/ 7.3	.005/ 6.8	.004/ 6.7
	9	.010/ 9.5	.011/ 9.5	.013/ 9.5	.015/ 9.5	.017/ 9.5	.018/ 9.5	.019/ 9.5	.018/ 9.5	.016/ 9.5	.014/ 9.5	.011/ 9.5	.008/ 9.5	.006/ 7.5
	11	.010/10.5	.011/10.5	.014/10.5	.017/10.8	.020/11.2	.022/11.6	.022/11.6	.022/11.6	.020/11.6	.017/11.6	.013/11.6	.009/11.6	.008/11.6
	13	.010/15.3	.012/15.0	.015/14.3	.019/14.0	.022/13.4	.024/13.1	.025/13.1	.024/13.1	.022/13.1	.019/13.1	.015/13.1	.011/13.1	.009/13.4
	15	.011/17.5	.012/17.0	.016/16.5	.020/15.7	.023/15.3	.026/15.3	.027/15.3	.026/15.0	.024/15.0	.021/14.6	.017/15.7	.013/15.7	.011/16.1
	17	.012/19.0	.013/18.5	.017/18.5	.021/18.0	.025/18.0	.027/17.5	.028/17.5	.027/17.5	.025/17.5	.022/17.5	.018/17.5	.014/17.5	.013/18.0
	19	.012/21.7	.014/21.7	.018/21.7	.022/20.9	.025/20.3	.028/19.0	.029/19.0	.028/19.0	.026/19.0	.023/19.0	.019/19.0	.016/19.6	.014/19.6
	21	.013/23.3	.014/23.3	.018/23.3	.022/22.4	.025/22.4	.028/22.4	.029/21.7	.028/21.7	.027/21.7	.023/20.9	.020/20.9	.016/20.9	.015/20.9
10	7	.013/12.8	.013/12.8	.013/12.8	.014/12.8	.015/12.8	.015/10.5	.014/ 7.9	.013/ 7.9	.011/ 7.7	.009/ 7.7	.007/ 7.5	.005/ 6.7	.004/ 6.3
	9	.014/12.8	.015/12.8	.016/12.8	.017/12.8	.019/12.8	.019/10.8	.019/10.5	.018/ 9.8	.016/ 9.5	.013/ 9.5	.010/ 9.2	.007/ 9.2	.005/ 9.2
	11	.013/12.8	.014/12.8	.016/12.8	.019/12.8	.021/12.8	.022/12.8	.023/11.2	.022/11.2	.020/11.2	.017/11.2	.013/11.2	.009/11.2	.007/11.2
	13	.012/12.8	.013/12.8	.016/12.8	.019/12.8	.022/12.8	.024/12.8	.025/12.8	.024/12.8	.022/12.8	.019/12.8	.015/12.6	.011/12.6	.009/12.6
	15	.011/12.8	.013/12.8	.016/12.8	.020/16.5	.023/15.7	.026/15.3	.026/15.3	.026/15.0	.024/14.3	.020/14.3	.016/14.3	.013/14.0	.011/14.0
	17	.012/21.7	.013/20.9	.017/18.5	.021/18.5	.024/18.0	.027/18.0	.028/17.5	.027/17.5	.025/17.5	.022/17.5	.018/17.0	.014/17.0	.013/17.0
	19	.012/23.3	.014/22.4	.017/22.4	.021/21.7	.025/20.9	.028/19.0	.029/19.0	.028/19.0	.026/19.0	.023/19.0	.019/19.0	.016/19.0	.014/19.0
	21	.013/25.1	.015/24.2	.018/24.2	.022/23.3	.025/22.4	.028/22.4	.029/21.7	.028/21.7	.026/20.9	.023/20.9	.020/20.9	.016/20.3	.015/20.3
15	7	.026/41.9	.025/41.9	.024/41.9	.022/41.9	.019/41.9	.016/17.5	.013/17.5	.014/14.3	.012/14.3	.009/ 7.5	.007/ 7.5	.004/ 7.3	.003/ 5.2
	9	.024/17.5	.023/17.5	.022/17.5	.021/17.5	.019/17.5	.018/17.5	.016/17.5	.019/14.3	.016/10.1	.013/ 9.0	.010/ 9.0	.007/ 9.0	.005/ 8.7
	11	.019/17.5	.019/17.5	.019/17.5	.019/17.5	.019/17.5	.018/17.5	.017/14.3	.022/14.3	.020/10.8	.016/10.8	.013/10.8	.009/10.5	.007/10.5
	13	.015/17.5	.015/17.5	.016/17.5	.017/17.5	.018/17.5	.019/14.3	.018/14.3	.024/14.3	.022/12.6	.019/12.6	.015/12.6	.011/12.1	.009/12.1
	15	.013/17.5	.013/17.5	.015/17.5	.016/17.5	.018/17.5	.019/17.5	.019/14.3	.026/14.3	.024/14.3	.020/14.0	.016/13.7	.013/13.4	.011/13.4
	17	.011/17.5	.012/17.5	.014/17.5	.016/17.5	.018/17.5	.020/17.5	.020/17.5	.027/17.5	.025/17.0	.022/17.0	.018/16.5	.014/16.5	.013/16.1
	19	.010/17.5	.011/17.5	.014/17.5	.016/17.5	.018/17.5	.020/19.6	.021/19.0	.028/19.0	.026/18.5	.023/18.5	.019/18.5	.015/18.5	.014/18.0
	21	.010/27.3	.011/26.2	.014/25.1	.016/23.3	.019/22.4	.020/21.7	.021/21.7	.028/20.9	.026/20.9	.023/20.3	.019/20.3	.016/19.6	.014/19.6
20	7	.141/37.0	.141/37.0	.140/37.0	.138/37.0	.132/37.0	.117/37.0	.095/37.0	.127/37.0	.066/37.0	.010/ 7.9	.007/ 7.7	.004/ 7.1	.003/ 6.7
	9	.111/34.9	.110/34.9	.107/34.9	.104/34.9	.098/34.9	.086/34.9	.069/34.9	.091/34.9	.049/34.9	.013/ 8.7	.010/ 8.7	.006/ 8.7	.005/ 8.3
	11	.083/34.9	.082/34.9	.080/34.9	.077/34.9	.071/34.9	.062/34.9	.050/34.9	.067/34.9	.038/34.9	.016/10.8	.012/10.5	.009/10.1	.007/ 9.8
	13	.063/33.1	.062/33.1	.060/34.9	.058/34.9	.054/34.9	.047/34.9	.038/34.9	.052/34.9	.032/34.9	.019/12.6	.015/12.1	.011/11.6	.009/11.6
	15	.049/33.1	.048/33.1	.047/33.1	.045/34.9	.042/34.9	.037/34.9	.030/34.9	.043/34.9	.029/34.9	.020/13.4	.016/13.4	.012/13.1	.011/12.8
	17	.038/33.1	.038/33.1	.037/33.1	.036/34.9	.034/34.9	.030/34.9	.026/34.9	.038/34.9	.028/34.9	.022/16.5	.018/16.1	.014/15.7	.012/14.3
	19	.031/33.1	.031/33.1	.031/33.1	.030/34.9	.028/34.9	.026/34.9	.023/34.9	.035/34.9	.028/19.0	.023/18.0	.019/18.0	.015/17.5	.014/17.5
	21	.026/33.1	.026/33.1	.026/33.1	.025/33.1	.025/34.9	.023/34.9	.021/34.9	.033/34.9	.028/20.3	.023/19.6	.019/19.6	.016/19.0	.014/19.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 26 - SHIP C, GM = 2 FT, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 2 FT (SPHERICAL TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{0E}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.013/ 8.5	.014/ 8.5	.015/ 8.5	.016/ 8.5	.018/ 8.5	.019/ 8.3	.019/ 8.3	.019/ 8.3	.018/ 8.5	.017/ 8.5	.016/ 8.5	.015/ 8.7	.014/ 8.7
	9	.023/11.6	.024/11.2	.025/10.8	.027/ 9.5	.029/ 9.8	.030/10.1	.031/10.1	.030/10.1	.029/10.1	.028/10.5	.026/ 8.7	.025/ 8.7	.025/11.2
	11	.035/12.6	.035/12.6	.036/12.6	.037/12.1	.037/11.6	.038/11.6	.039/11.6	.039/11.6	.038/11.6	.038/12.1	.037/12.6	.037/12.6	.037/12.6
	13	.045/13.7	.045/13.7	.045/13.7	.044/13.4	.043/13.1	.042/12.8	.042/12.6	.042/12.8	.043/13.1	.045/13.4	.046/13.4	.047/13.7	.047/13.7
	15	.051/15.0	.051/15.0	.049/14.6	.047/14.6	.045/14.3	.043/14.0	.042/14.0	.043/14.0	.045/14.3	.048/14.6	.050/14.6	.052/14.6	.052/14.6
	17	.053/15.7	.052/15.7	.050/15.7	.047/15.7	.044/15.7	.042/15.3	.041/15.0	.042/15.0	.044/15.3	.048/15.7	.051/15.7	.053/15.7	.054/15.7
	19	.052/17.0	.052/17.0	.049/17.0	.046/17.0	.042/16.5	.039/16.1	.038/16.1	.039/16.1	.042/16.5	.046/16.5	.050/17.0	.052/17.0	.053/17.0
	21	.050/18.0	.049/18.0	.047/18.0	.043/18.0	.040/17.5	.037/17.5	.035/17.5	.037/17.5	.040/17.5	.044/17.5	.047/18.0	.050/18.0	.050/18.0
5	7	.014/10.5	.014/10.5	.015/ 9.5	.017/ 9.2	.018/ 9.2	.019/ 8.3	.019/ 8.3	.019/ 8.1	.018/ 7.9	.016/ 7.5	.015/ 7.3	.014/ 7.3	.013/ 7.3
	9	.023/10.8	.024/10.8	.025/10.5	.027/10.5	.029/10.5	.030/10.1	.030/ 9.8	.030/ 9.8	.029/ 9.8	.027/ 9.8	.026/10.1	.024/10.1	.024/10.1
	11	.035/14.3	.035/14.3	.035/14.3	.036/14.0	.037/13.4	.038/11.6	.038/11.2	.038/10.8	.038/10.8	.038/10.8	.038/11.2	.037/11.2	.037/11.2
	13	.044/15.3	.044/15.3	.044/15.3	.043/15.0	.042/14.6	.042/14.0	.042/12.8	.043/12.1	.044/12.1	.045/12.1	.046/12.1	.047/12.1	.048/12.1
	15	.050/16.5	.050/16.5	.048/16.5	.046/16.1	.044/15.7	.042/15.3	.042/14.3	.043/13.4	.046/13.1	.048/13.4	.051/13.4	.053/13.4	.053/13.4
	17	.052/17.5	.051/17.5	.049/17.5	.047/17.5	.043/17.0	.041/16.5	.041/15.3	.042/14.6	.045/14.3	.049/14.3	.052/14.3	.054/14.3	.055/14.3
	19	.052/18.5	.051/18.5	.048/18.5	.045/18.5	.042/18.0	.039/17.5	.038/16.5	.040/15.7	.043/15.3	.047/15.3	.051/15.3	.053/15.3	.054/15.3
	21	.049/19.6	.048/19.6	.046/19.6	.043/19.0	.039/19.0	.036/18.5	.035/17.5	.037/16.5	.040/16.5	.044/16.5	.048/16.5	.050/16.5	.051/16.5
10	7	.014/12.8	.015/12.8	.016/12.8	.017/12.8	.018/ 8.7	.019/ 8.7	.019/ 8.7	.019/ 8.5	.017/ 8.3	.016/ 6.3	.015/ 6.3	.014/ 6.3	.013/ 6.3
	9	.023/14.0	.023/14.0	.025/14.0	.027/13.7	.028/12.8	.030/11.2	.030/ 9.5	.029/ 9.2	.028/ 9.2	.027/ 9.2	.025/ 9.2	.024/ 9.2	.023/ 9.2
	11	.034/17.0	.034/17.0	.035/16.5	.035/16.5	.036/14.0	.037/14.0	.038/10.8	.038/10.5	.038/10.1	.038/10.1	.037/10.1	.037/10.1	.037/10.1
	13	.043/18.0	.043/17.5	.043/17.5	.042/17.5	.041/17.0	.041/16.1	.041/12.1	.042/11.2	.044/11.2	.045/11.2	.047/11.2	.048/11.2	.048/11.2
	15	.049/18.5	.048/18.5	.047/18.5	.045/18.5	.043/18.0	.042/17.5	.042/15.3	.043/12.6	.046/12.1	.049/12.1	.051/12.1	.053/12.1	.054/12.1
	17	.051/19.6	.050/19.6	.048/19.6	.046/19.0	.043/19.0	.041/18.0	.041/16.5	.042/14.0	.045/13.4	.049/13.4	.052/13.4	.055/13.4	.056/13.4
	19	.051/20.3	.050/20.3	.048/20.3	.044/20.3	.041/19.6	.039/19.0	.038/17.5	.040/15.3	.043/14.6	.047/14.3	.051/14.3	.054/14.3	.055/14.3
	21	.049/21.7	.048/21.7	.045/20.9	.042/20.9	.039/20.9	.036/20.3	.035/18.5	.037/16.5	.040/15.7	.045/15.3	.048/15.3	.051/15.3	.052/15.3
15	7	.014/17.5	.014/17.5	.015/14.3	.017/14.3	.018/10.1	.019/10.1	.019/10.1	.018/10.1	.017/10.1	.016/ 6.8	.014/ 5.7	.013/ 5.7	.013/ 5.7
	9	.022/20.3	.023/20.3	.024/20.3	.026/14.3	.028/14.3	.029/14.3	.029/10.1	.029/ 9.0	.028/ 9.0	.026/ 8.7	.024/ 8.7	.023/ 8.7	.022/ 8.7
	11	.032/20.3	.033/20.3	.034/20.3	.035/20.3	.036/20.3	.037/14.3	.037/10.1	.037/ 9.5	.037/ 9.5	.037/ 9.5	.036/ 9.5	.036/ 9.5	.036/ 9.5
	13	.042/20.9	.042/20.9	.041/20.9	.041/20.9	.040/20.3	.040/18.5	.041/10.5	.042/10.5	.044/10.5	.045/10.5	.047/10.5	.048/10.5	.048/10.5
	15	.048/21.7	.047/21.7	.046/21.7	.044/20.9	.042/20.9	.041/20.3	.042/19.0	.043/11.6	.046/11.2	.049/11.2	.052/11.2	.054/11.2	.054/11.2
	17	.050/22.4	.049/22.4	.048/22.4	.045/21.7	.042/21.7	.040/20.9	.040/19.6	.042/13.1	.045/12.6	.049/12.6	.053/12.6	.055/12.6	.056/12.6
	19	.050/23.3	.049/22.4	.047/22.4	.044/22.4	.041/22.4	.038/21.7	.038/20.3	.040/14.3	.044/13.7	.048/13.4	.052/13.4	.054/13.4	.055/13.4
	21	.048/23.3	.047/23.3	.045/23.3	.042/23.3	.038/23.3	.036/22.4	.035/20.9	.037/16.1	.041/14.6	.045/14.6	.049/14.3	.051/14.3	.052/14.3
20	7	.013/13.4	.014/13.4	.015/13.4	.017/13.4	.018/13.4	.019/13.4	.019/13.4	.018/13.4	.017/ 9.8	.016/ 6.4	.014/ 4.8	.013/ 4.8	.013/ 4.8
	9	.021/19.0	.022/19.0	.023/19.0	.025/19.0	.027/19.0	.028/19.0	.029/19.0	.028/ 8.7	.027/ 8.5	.025/ 8.3	.023/ 8.3	.022/ 8.3	.021/ 8.3
	11	.031/23.3	.032/23.3	.033/23.3	.034/23.3	.035/19.0	.036/19.0	.036/19.0	.037/ 9.2	.036/ 9.0	.036/ 9.0	.035/ 9.0	.035/ 9.0	.035/ 9.0
	13	.041/26.2	.041/23.3	.040/23.3	.040/23.3	.040/23.3	.040/23.3	.040/19.6	.042/ 9.8	.043/ 9.8	.045/ 9.8	.046/ 9.8	.047/ 9.8	.047/ 9.8
	15	.047/26.2	.046/26.2	.045/26.2	.043/26.2	.042/23.3	.041/23.3	.041/23.3	.043/10.8	.046/10.8	.049/10.5	.051/10.5	.053/10.5	.054/10.5
	17	.049/27.3	.049/27.3	.047/26.2	.044/26.2	.042/26.2	.040/23.3	.040/23.3	.042/11.6	.045/11.6	.049/11.6	.053/11.6	.055/11.6	.056/11.6
	19	.049/27.3	.048/27.3	.046/27.3	.043/27.3	.040/26.2	.038/26.2	.038/23.3	.040/13.4	.044/12.6	.048/12.6	.052/12.6	.054/12.6	.055/12.6
	21	.047/27.3	.046/27.3	.044/27.3	.041/27.3	.038/27.3	.035/26.2	.035/23.3	.037/15.3	.041/14.0	.045/13.7	.049/13.4	.052/13.4	.053/13.4

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 27 - SHIP C, GM = 2 FT, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 2 FT (SPHERICAL TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.026/ 8.9	.036/ 8.1	.056/ 7.7	.077/ 7.7	.094/ 7.5	.107/ 7.5	.112/ 7.5	.111/ 7.5	.103/ 7.3	.088/ 7.3	.069/ 7.3	.049/ 7.3	.038/ 7.3
	9	.045/10.1	.054/ 9.8	.075/ 9.5	.099/ 9.2	.118/ 9.2	.132/ 9.0	.137/ 9.0	.135/ 9.0	.125/ 9.0	.107/ 9.0	.085/ 9.2	.063/ 9.5	.052/10.1
	11	.057/11.2	.065/11.2	.084/10.8	.105/10.5	.124/10.5	.136/10.5	.141/10.5	.138/10.5	.128/10.5	.111/10.5	.090/10.8	.070/11.2	.060/11.2
	13	.061/12.1	.068/12.1	.084/12.1	.102/11.6	.119/11.6	.130/11.6	.134/11.6	.131/11.6	.121/11.6	.106/11.6	.088/12.1	.070/12.1	.063/12.1
	15	.060/13.1	.065/13.1	.079/12.8	.095/12.8	.110/12.6	.119/12.6	.123/12.6	.120/12.6	.112/12.6	.098/12.8	.082/12.8	.067/13.1	.061/13.1
	17	.056/14.3	.061/14.0	.073/14.0	.087/14.0	.099/13.7	.108/13.7	.111/13.7	.108/13.7	.101/13.7	.089/13.7	.075/14.0	.063/14.0	.057/14.3
	19	.052/15.0	.056/15.0	.066/15.0	.078/15.0	.089/14.6	.097/14.6	.099/15.0	.097/15.0	.091/15.0	.080/15.3	.068/15.7	.057/15.7	.053/15.7
	21	.047/15.7	.051/15.7	.060/15.7	.070/16.1	.080/16.1	.086/16.1	.089/16.5	.087/16.5	.081/16.5	.072/16.5	.061/16.5	.052/16.5	.048/16.5
5	7	.024/ 9.2	.034/ 8.3	.055/ 8.1	.076/ 7.7	.094/ 7.5	.107/ 7.3	.114/ 7.3	.113/ 7.3	.105/ 7.3	.091/ 7.1	.071/ 7.0	.051/ 6.8	.040/ 6.7
	9	.042/11.2	.052/10.8	.073/ 9.8	.097/ 9.5	.117/ 9.2	.132/ 9.0	.138/ 9.0	.137/ 8.7	.127/ 8.7	.110/ 8.7	.088/ 8.7	.065/ 8.7	.054/ 9.0
	11	.053/12.6	.062/12.1	.081/11.6	.103/11.2	.122/10.8	.135/10.5	.141/10.5	.140/10.1	.130/10.1	.114/10.1	.093/10.1	.073/10.1	.063/10.1
	13	.057/13.4	.064/13.4	.080/12.8	.100/12.6	.117/12.1	.129/11.6	.134/11.6	.132/11.2	.124/11.2	.109/11.2	.091/11.2	.073/11.2	.066/11.2
	15	.056/14.3	.062/14.3	.076/14.0	.093/13.7	.107/13.1	.118/12.8	.123/12.6	.121/12.6	.113/12.1	.101/12.1	.085/12.1	.070/12.1	.064/12.1
	17	.053/15.3	.058/15.0	.070/15.0	.084/14.6	.097/14.3	.107/14.0	.111/13.7	.109/13.4	.103/13.4	.091/13.1	.078/13.1	.065/13.1	.060/13.1
	19	.048/16.5	.053/16.1	.063/15.7	.076/15.7	.087/15.3	.096/15.3	.099/15.0	.098/14.6	.092/14.6	.082/14.3	.070/14.3	.060/14.0	.055/14.0
	21	.044/17.5	.048/17.5	.057/17.0	.068/17.0	.078/17.0	.085/16.5	.089/16.5	.088/16.1	.082/16.1	.074/16.1	.063/16.1	.054/15.7	.050/15.7
10	7	.022/11.6	.032/ 8.7	.053/ 8.3	.075/ 7.3	.094/ 7.1	.108/ 7.0	.115/ 7.0	.114/ 7.0	.106/ 7.0	.092/ 6.8	.073/ 6.8	.052/ 6.8	.041/ 6.8
	9	.039/12.8	.049/11.6	.071/10.8	.095/ 9.5	.116/ 8.7	.132/ 8.7	.139/ 8.7	.138/ 8.5	.129/ 8.3	.112/ 8.3	.090/ 8.3	.068/ 8.3	.056/ 8.3
	11	.050/14.3	.058/14.0	.077/12.8	.100/11.6	.120/11.2	.135/10.8	.142/10.1	.141/ 9.8	.132/ 9.5	.116/ 9.5	.096/ 9.5	.075/ 9.5	.066/ 9.5
	13	.053/15.3	.060/15.0	.077/14.3	.097/13.4	.115/12.6	.128/12.1	.134/11.6	.133/11.2	.125/10.8	.111/10.8	.093/10.5	.076/10.5	.068/10.5
	15	.052/16.1	.058/15.7	.072/15.3	.090/14.6	.105/14.0	.117/13.4	.123/12.8	.122/12.6	.115/12.1	.103/11.6	.087/11.6	.073/11.2	.066/11.2
	17	.049/17.0	.054/17.0	.066/16.1	.082/15.7	.095/15.3	.105/14.6	.111/14.3	.110/13.7	.104/13.1	.093/12.6	.080/12.6	.068/12.6	.062/12.1
	19	.045/18.0	.050/17.5	.060/17.0	.074/17.0	.086/16.1	.095/15.7	.099/15.3	.099/14.6	.094/14.3	.084/14.0	.072/13.7	.062/13.4	.057/13.4
	21	.041/18.5	.045/18.5	.054/18.0	.066/17.5	.077/17.5	.085/17.0	.089/16.5	.088/16.1	.084/15.7	.075/15.3	.065/15.3	.056/14.3	.052/14.3
15	7	.020/12.1	.031/10.1	.052/ 9.2	.075/ 6.8	.094/ 6.7	.108/ 6.7	.116/ 6.7	.115/ 6.7	.108/ 6.7	.094/ 6.7	.074/ 6.7	.053/ 6.5	.041/ 6.5
	9	.036/15.3	.046/12.6	.068/12.1	.093/ 9.5	.115/ 9.2	.131/ 8.5	.140/ 8.1	.139/ 7.9	.131/ 7.9	.115/ 7.7	.093/ 7.7	.070/ 7.7	.058/ 7.7
	11	.046/15.7	.054/15.7	.074/12.8	.097/12.8	.118/10.1	.134/10.1	.142/ 9.5	.142/ 9.5	.134/ 9.2	.118/ 9.0	.098/ 8.7	.078/ 8.7	.068/ 8.7
	13	.049/18.0	.056/18.0	.073/15.7	.094/13.4	.112/12.8	.127/12.6	.134/11.2	.134/10.5	.127/10.5	.114/10.1	.096/10.1	.078/ 9.8	.070/ 9.8
	15	.048/18.5	.054/18.0	.069/18.0	.087/15.7	.103/15.3	.116/13.4	.123/12.8	.123/12.1	.117/11.6	.105/11.2	.090/10.8	.075/10.8	.068/10.8
	17	.045/19.6	.050/19.6	.063/18.0	.079/17.5	.093/15.7	.104/15.3	.111/14.0	.111/13.4	.106/12.8	.095/12.1	.082/12.1	.070/11.6	.064/11.6
	19	.042/19.6	.046/19.6	.057/19.6	.071/18.0	.084/17.5	.094/16.5	.099/15.7	.099/15.0	.095/14.0	.086/13.4	.074/12.8	.064/12.6	.059/12.6
	21	.038/20.3	.042/20.3	.052/19.6	.064/18.5	.075/18.5	.084/18.0	.088/17.0	.089/16.1	.085/15.7	.077/15.0	.067/14.0	.058/13.7	.054/13.4
20	7	.019/13.7	.029/13.7	.051/13.7	.074/ 6.7	.094/ 6.7	.108/ 6.7	.116/ 6.5	.116/ 6.4	.109/ 6.4	.095/ 6.4	.075/ 6.3	.054/ 6.3	.042/ 6.3
	9	.033/19.0	.043/19.0	.066/14.3	.091/10.1	.114/ 7.9	.131/ 7.7	.140/ 7.7	.140/ 7.5	.132/ 7.5	.116/ 7.3	.094/ 7.3	.071/ 7.1	.059/ 7.1
	11	.041/19.0	.050/19.0	.070/19.0	.095/14.6	.116/10.8	.133/10.1	.142/ 9.8	.143/ 8.7	.135/ 8.5	.120/ 8.5	.100/ 8.3	.079/ 8.3	.070/ 8.3
	13	.044/19.0	.051/19.0	.069/19.0	.090/19.0	.110/14.6	.125/11.2	.134/10.8	.135/10.5	.129/10.1	.115/ 9.8	.098/ 9.2	.080/ 9.2	.072/ 9.0
	15	.043/23.3	.049/23.3	.065/19.0	.083/19.0	.101/15.0	.115/14.6	.122/12.1	.124/11.6	.118/11.2	.107/10.8	.092/10.5	.077/10.5	.070/10.1
	17	.041/23.3	.046/23.3	.060/19.0	.076/19.0	.091/19.0	.103/15.0	.110/14.6	.112/14.0	.107/12.1	.097/11.6	.084/11.2	.071/11.2	.066/10.8
	19	.038/23.3	.043/23.3	.054/23.3	.068/19.0	.082/19.0	.093/15.7	.099/15.3	.100/15.0	.096/14.3	.087/13.1	.076/12.6	.065/12.1	.061/12.1
	21	.035/23.3	.039/23.3	.049/23.3	.062/19.0	.073/19.0	.083/19.0	.088/16.5	.089/16.1	.086/15.3	.078/14.6	.068/13.7	.059/13.1	.055/12.8

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 28 - SHIP C, GM = 2 FT, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 2 FT (SPHERICAL TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.094/ 8.5	.101/ 8.5	.118/ 8.5	.139/ 8.5	.157/ 8.5	.170/ 8.5	.176/ 8.5	.173/ 8.5	.163/ 8.3	.146/ 8.3	.127/ 8.3	.111/ 8.3	.105/ 8.3
	9	.159/ 8.7	.169/ 8.7	.195/ 8.7	.224/ 9.0	.250/ 9.2	.268/ 9.2	.275/ 9.2	.270/ 9.2	.255/ 9.2	.231/ 9.2	.204/ 9.5	.182/ 9.5	.173/ 9.5
	11	.190/11.2	.198/11.2	.220/10.5	.246/10.1	.269/ 9.5	.286/ 9.5	.292/ 9.5	.288/ 9.5	.274/ 9.8	.252/ 9.8	.229/10.5	.210/10.8	.203/10.8
	13	.193/11.6	.199/11.6	.215/11.6	.234/10.8	.252/10.5	.265/10.1	.271/10.1	.267/10.1	.257/10.5	.240/10.8	.223/11.2	.209/11.6	.204/11.6
	15	.182/12.6	.187/12.6	.198/12.1	.212/11.6	.225/10.8	.234/10.5	.239/10.5	.236/10.5	.228/10.8	.217/11.6	.204/12.1	.194/12.1	.191/12.6
	17	.166/13.1	.169/13.1	.177/12.8	.187/12.1	.197/11.6	.204/10.8	.207/10.5	.206/10.8	.200/11.6	.191/12.1	.182/12.6	.175/12.8	.173/13.1
	19	.149/13.7	.151/13.4	.157/13.4	.164/12.8	.172/12.1	.177/11.2	.179/10.8	.178/11.2	.174/12.1	.168/12.6	.161/13.1	.156/13.4	.154/13.4
	21	.132/14.3	.134/14.3	.138/14.0	.144/13.4	.150/12.6	.154/11.6	.156/11.2	.155/11.6	.152/12.6	.147/13.1	.142/13.7	.138/14.0	.136/14.0
5	7	.089/ 9.5	.099/ 9.2	.120/ 9.0	.143/ 8.7	.162/ 8.3	.175/ 8.3	.180/ 8.3	.175/ 8.3	.162/ 8.3	.143/ 8.3	.121/ 8.1	.102/ 7.9	.095/ 7.5
	9	.128/ 9.5	.142/ 9.5	.173/ 9.5	.208/ 9.5	.241/ 9.2	.265/ 9.2	.278/ 9.2	.278/ 9.2	.267/ 9.0	.246/ 9.2	.222/ 9.2	.201/ 9.2	.193/ 9.2
	11	.146/12.8	.157/12.8	.185/ 9.8	.219/ 9.8	.252/ 9.5	.280/ 9.5	.298/ 9.5	.305/ 9.5	.301/ 9.5	.289/ 9.8	.273/ 9.8	.260/ 9.8	.255/ 9.8
	13	.147/13.7	.156/13.7	.177/13.4	.205/10.5	.233/ 9.8	.259/ 9.8	.277/ 9.8	.288/ 9.8	.290/10.1	.285/10.1	.277/10.1	.270/10.5	.267/10.5
	15	.140/14.6	.146/14.3	.162/14.3	.183/13.4	.207/10.5	.228/10.1	.245/10.1	.256/10.1	.261/10.5	.261/10.5	.258/10.8	.254/10.8	.253/10.8
	17	.128/15.0	.133/15.0	.145/15.0	.162/14.3	.180/13.1	.198/10.5	.213/10.5	.224/10.5	.230/10.5	.231/10.8	.231/10.8	.229/11.2	.229/11.2
	19	.116/15.7	.119/15.7	.129/15.3	.142/15.0	.157/14.0	.172/10.8	.184/10.5	.194/10.5	.200/10.8	.203/11.2	.204/11.2	.203/11.2	.203/11.6
	21	.104/16.5	.106/16.5	.114/16.1	.125/15.7	.137/14.6	.149/10.8	.160/10.8	.169/10.8	.174/10.8	.177/11.2	.179/11.6	.179/11.6	.179/11.6
10	7	.065/10.1	.080/10.1	.111/ 8.5	.140/ 8.5	.164/ 8.5	.178/ 8.5	.183/ 8.3	.178/ 8.3	.163/ 8.1	.140/ 8.1	.115/ 7.9	.094/ 7.9	.086/ 7.9
	9	.093/10.5	.111/10.5	.149/ 9.8	.191/ 8.7	.229/ 8.7	.259/ 8.7	.277/ 8.7	.281/ 8.7	.273/ 8.7	.254/ 8.7	.230/ 8.7	.210/ 8.7	.202/ 8.7
	11	.106/15.7	.120/15.7	.155/10.5	.196/ 9.8	.238/ 9.5	.275/ 9.5	.304/ 9.2	.321/ 9.2	.327/ 9.2	.323/ 9.2	.313/ 9.2	.304/ 9.2	.300/ 9.2
	13	.108/16.5	.119/16.1	.146/16.1	.182/10.5	.220/ 9.8	.257/ 9.5	.288/ 9.5	.312/ 9.5	.327/ 9.5	.333/ 9.5	.334/ 9.8	.332/ 9.8	.332/ 9.8
	15	.104/17.0	.112/17.0	.133/16.5	.162/10.8	.194/10.1	.227/ 9.8	.257/ 9.8	.282/ 9.8	.300/ 9.8	.311/ 9.8	.317/ 9.8	.319/ 9.8	.320/ 9.8
	17	.097/17.5	.103/17.5	.119/17.5	.142/16.5	.169/10.5	.198/ 9.8	.225/ 9.8	.248/ 9.8	.266/ 9.8	.278/ 9.8	.286/10.1	.290/10.1	.291/10.1
	19	.089/18.5	.093/18.0	.106/18.0	.125/17.5	.147/10.5	.171/10.1	.195/ 9.8	.215/ 9.8	.232/10.1	.245/10.1	.253/10.1	.257/10.1	.259/10.1
	21	.080/19.0	.084/19.0	.094/18.5	.110/18.0	.128/17.0	.149/10.1	.169/10.1	.187/10.1	.202/10.1	.214/10.1	.222/10.1	.226/10.5	.228/10.5
15	7	.056/ 8.7	.077/ 8.5	.112/ 8.5	.144/ 8.5	.169/ 8.5	.184/ 8.5	.189/ 8.5	.182/ 8.3	.165/ 8.3	.140/ 8.3	.112/ 7.9	.089/ 7.7	.080/ 7.5
	9	.073/12.1	.094/ 9.2	.137/ 9.2	.183/ 9.2	.224/ 8.7	.257/ 8.7	.277/ 8.5	.283/ 8.5	.276/ 8.5	.258/ 8.5	.233/ 8.5	.211/ 8.5	.202/ 8.5
	11	.080/20.3	.097/12.6	.136/ 9.5	.183/ 9.2	.232/ 9.2	.277/ 9.0	.313/ 9.0	.338/ 9.0	.350/ 9.0	.351/ 9.0	.345/ 9.0	.338/ 9.0	.334/ 9.0
	13	.081/20.3	.094/20.3	.126/12.6	.168/ 9.2	.215/ 9.2	.262/ 9.2	.304/ 9.2	.339/ 9.2	.364/ 9.2	.379/ 9.2	.387/ 9.2	.390/ 9.2	.390/ 9.2
	15	.078/20.3	.088/20.3	.113/20.3	.148/ 9.5	.190/ 9.2	.233/ 9.2	.275/ 9.2	.311/ 9.2	.341/ 9.2	.362/ 9.5	.376/ 9.5	.384/ 9.5	.386/ 9.5
	17	.074/20.9	.081/20.9	.101/20.9	.130/ 9.5	.165/ 9.5	.203/ 9.2	.241/ 9.5	.276/ 9.5	.305/ 9.5	.328/ 9.5	.343/ 9.5	.353/ 9.5	.356/ 9.5
	19	.068/21.7	.074/21.7	.090/20.9	.114/20.3	.143/ 9.5	.176/ 9.5	.210/ 9.5	.241/ 9.5	.268/ 9.5	.289/ 9.5	.305/ 9.5	.314/ 9.5	.317/ 9.5
	21	.062/21.7	.067/21.7	.080/21.7	.100/20.9	.125/ 9.5	.153/ 9.5	.182/ 9.5	.210/ 9.5	.234/ 9.5	.253/ 9.5	.268/ 9.8	.277/ 9.8	.280/ 9.8
20	7	.052/ 9.0	.073/ 9.0	.109/ 9.0	.142/ 9.0	.167/ 9.0	.182/ 9.0	.187/ 9.0	.180/ 9.0	.164/ 9.0	.139/ 7.7	.110/ 7.7	.086/ 7.5	.078/ 5.2
	9	.061/14.0	.083/ 9.5	.128/ 9.2	.175/ 9.0	.218/ 9.0	.252/ 9.0	.274/ 8.7	.282/ 8.5	.275/ 8.3	.256/ 8.3	.230/ 8.3	.206/ 8.3	.197/ 8.3
	11	.063/19.0	.082/19.0	.123/ 9.2	.175/ 9.0	.229/ 9.0	.280/ 9.0	.322/ 8.7	.352/ 8.7	.368/ 8.7	.372/ 8.7	.367/ 8.7	.360/ 8.5	.356/ 8.5
	13	.062/23.3	.077/23.3	.112/ 9.8	.160/ 9.0	.214/ 9.0	.270/ 9.0	.321/ 9.0	.365/ 9.0	.398/ 9.0	.420/ 9.0	.433/ 9.0	.438/ 9.0	.440/ 9.0
	15	.060/23.3	.071/23.3	.100/23.3	.141/ 9.2	.190/ 9.0	.243/ 9.0	.295/ 9.0	.342/ 9.0	.382/ 9.0	.412/ 9.0	.432/ 9.0	.444/ 9.0	.448/ 9.0
	17	.057/26.2	.065/26.2	.088/23.3	.123/ 9.2	.165/ 9.0	.213/ 9.0	.261/ 9.0	.306/ 9.0	.346/ 9.0	.377/ 9.0	.400/ 9.0	.414/ 9.0	.418/ 9.0
	19	.053/26.2	.060/26.2	.078/26.2	.107/ 9.2	.144/ 9.0	.185/ 9.0	.228/ 9.0	.269/ 9.0	.305/ 9.2	.335/ 9.2	.357/ 9.2	.371/ 9.2	.376/ 9.2
	21	.049/27.3	.054/27.3	.070/26.2	.094/23.3	.125/ 9.2	.161/ 9.0	.198/ 9.0	.234/ 9.2	.267/ 9.2	.295/ 9.2	.315/ 9.2	.328/ 9.2	.332/ 9.2

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 29 - SHIP C, GM = 3 FT, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 3 FT (SPHERICAL TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.006/ 7.9	.006/ 7.9	.008/ 7.9	.010/ 7.9	.011/ 7.7	.012/ 7.7	.013/ 7.7	.012/ 7.7	.011/ 7.7	.010/ 7.9	.008/ 7.9	.007/ 7.9	.006/ 7.9
	9	.007/ 8.5	.008/ 8.7	.011/ 8.7	.013/ 9.2	.015/ 9.5	.017/ 9.5	.017/ 9.5	.017/ 9.5	.016/ 9.5	.013/ 9.2	.011/ 8.7	.009/ 8.7	.008/ 8.7
	11	.008/ 8.7	.009/12.1	.012/11.6	.016/11.6	.018/11.6	.020/11.6	.021/11.6	.020/11.6	.018/11.6	.016/11.6	.013/11.6	.009/12.1	.008/ 8.7
	13	.009/14.3	.010/14.3	.014/13.7	.017/13.1	.020/13.1	.022/13.1	.023/13.1	.022/13.1	.020/13.1	.017/13.4	.014/13.4	.010/13.7	.009/14.0
	15	.010/16.5	.011/15.7	.015/15.3	.018/15.3	.022/15.3	.024/15.3	.025/15.7	.024/15.7	.022/15.7	.019/16.1	.015/16.5	.012/17.0	.010/17.0
	17	.011/18.5	.012/18.0	.016/18.0	.020/18.0	.023/18.0	.025/18.0	.026/18.0	.026/18.0	.024/18.0	.021/18.5	.017/18.5	.014/19.0	.012/19.0
	19	.012/21.7	.013/21.7	.017/21.7	.021/21.7	.024/20.9	.026/20.9	.027/20.9	.027/20.9	.025/20.9	.022/20.9	.018/20.9	.015/20.9	.013/20.9
	21	.014/25.1	.015/25.1	.018/24.2	.022/24.2	.025/24.2	.027/23.3	.028/23.3	.028/23.3	.026/22.4	.023/22.4	.019/22.4	.016/22.4	.014/22.4
5	7	.008/ 9.5	.009/ 9.5	.010/ 9.2	.011/ 9.2	.012/ 7.9	.013/ 7.9	.013/ 7.9	.012/ 7.7	.011/ 7.7	.009/ 7.5	.007/ 7.1	.005/ 6.8	.004/ 6.7
	9	.010/ 9.5	.011/ 9.5	.012/ 9.5	.014/ 9.5	.016/ 9.5	.017/ 9.5	.018/ 9.5	.017/ 9.5	.015/ 9.5	.013/ 9.5	.010/ 9.5	.007/ 7.5	.006/ 7.5
	11	.010/10.5	.011/10.5	.013/10.5	.016/10.8	.019/11.2	.020/11.2	.021/11.2	.020/11.6	.018/11.6	.015/11.6	.012/11.6	.009/11.6	.007/11.6
	13	.009/10.5	.011/14.6	.014/14.3	.017/14.0	.020/13.4	.022/13.1	.023/13.1	.022/13.1	.020/13.1	.017/13.1	.014/13.1	.010/13.1	.009/13.4
	15	.010/17.5	.011/17.5	.015/17.0	.018/15.7	.021/15.3	.024/15.3	.024/15.3	.024/15.3	.022/15.3	.019/15.7	.015/15.7	.012/16.1	.010/16.1
	17	.011/19.0	.012/18.5	.016/18.5	.019/18.0	.023/18.0	.025/18.0	.026/18.0	.025/18.0	.024/18.0	.021/18.0	.017/18.0	.013/18.0	.012/18.0
	19	.012/23.3	.013/22.4	.017/22.4	.021/21.7	.024/21.7	.026/20.9	.027/20.9	.027/20.3	.025/20.3	.022/20.3	.018/20.3	.015/20.3	.013/20.3
	21	.014/25.1	.015/25.1	.018/25.1	.022/24.2	.025/24.2	.028/23.3	.029/23.3	.028/23.3	.026/22.4	.023/22.4	.019/22.4	.016/21.7	.014/21.7
10	7	.013/12.8	.013/12.8	.014/12.8	.014/12.8	.015/12.8	.015/12.8	.014/ 7.9	.012/ 7.7	.011/ 7.7	.009/ 7.5	.007/ 7.5	.005/ 6.5	.004/ 6.3
	9	.015/12.8	.015/12.8	.016/12.8	.017/12.8	.018/12.8	.019/10.8	.018/10.5	.017/ 9.8	.015/ 9.5	.013/ 9.5	.010/ 9.2	.007/ 9.2	.005/ 9.2
	11	.013/12.8	.014/12.8	.016/12.8	.018/12.8	.020/12.8	.021/12.8	.021/11.2	.020/11.2	.018/11.2	.015/11.2	.012/11.2	.008/11.2	.007/11.2
	13	.012/12.8	.013/12.8	.015/12.8	.018/12.8	.021/12.8	.022/12.8	.023/12.8	.022/12.8	.020/12.8	.017/12.6	.014/12.6	.010/12.6	.008/12.8
	15	.011/12.8	.012/12.8	.015/12.8	.019/12.8	.022/15.3	.024/15.3	.024/15.3	.024/14.6	.022/14.3	.019/14.3	.015/14.0	.012/14.0	.010/14.0
	17	.011/12.8	.012/21.7	.016/18.5	.019/18.5	.023/18.0	.025/18.0	.026/18.0	.025/17.5	.023/17.5	.020/17.5	.017/17.5	.013/17.5	.012/17.5
	19	.012/24.2	.014/24.2	.017/23.3	.021/22.4	.024/21.7	.026/21.7	.027/20.9	.027/20.3	.025/19.6	.022/19.0	.018/19.0	.015/19.0	.013/19.0
	21	.015/26.2	.016/25.1	.019/25.1	.023/24.2	.026/23.3	.028/23.3	.029/22.4	.028/22.4	.026/22.4	.023/21.7	.019/21.7	.016/21.7	.014/20.9
15	7	.025/17.5	.025/17.5	.023/17.5	.021/17.5	.019/17.5	.016/17.5	.013/14.3	.014/14.3	.011/14.3	.009/ 7.5	.006/ 7.3	.004/ 7.1	.003/ 5.2
	9	.025/17.5	.025/17.5	.024/17.5	.022/17.5	.020/17.5	.018/17.5	.015/14.3	.018/14.3	.015/10.1	.012/ 9.0	.009/ 9.0	.006/ 9.0	.005/ 8.7
	11	.021/17.5	.021/17.5	.020/17.5	.019/17.5	.019/17.5	.018/17.5	.016/14.3	.020/14.3	.018/10.8	.015/10.8	.012/10.8	.008/10.5	.006/10.5
	13	.017/17.5	.017/17.5	.017/17.5	.017/17.5	.018/17.5	.018/14.3	.017/14.3	.022/14.3	.020/12.6	.017/12.6	.013/12.6	.010/12.1	.008/12.1
	15	.014/17.5	.014/17.5	.015/17.5	.016/17.5	.017/17.5	.018/17.5	.018/14.3	.024/14.3	.022/14.3	.019/14.0	.015/13.7	.012/13.4	.010/13.4
	17	.012/17.5	.013/17.5	.014/17.5	.016/17.5	.017/17.5	.019/17.5	.019/17.5	.025/17.5	.023/17.5	.020/17.0	.017/17.0	.013/17.0	.012/16.5
	19	.014/29.9	.014/29.9	.015/17.5	.017/17.5	.019/21.7	.020/21.7	.020/20.9	.027/19.0	.025/19.0	.022/19.0	.018/19.0	.015/18.5	.013/18.5
	21	.016/29.9	.017/29.9	.018/29.9	.020/29.9	.021/23.3	.022/22.4	.022/21.7	.029/21.7	.026/20.9	.023/20.9	.019/20.9	.015/20.9	.014/20.3
20	7	.102/29.9	.100/29.9	.093/29.9	.084/29.9	.073/29.9	.059/29.9	.043/29.9	.048/29.9	.021/34.9	.009/ 7.9	.006/ 7.9	.004/ 7.1	.003/ 6.5
	9	.125/29.9	.121/29.9	.112/29.9	.099/29.9	.083/29.9	.065/29.9	.046/29.9	.048/28.6	.020/34.9	.012/ 8.7	.009/ 8.7	.006/ 8.7	.004/ 8.3
	11	.107/29.9	.104/29.9	.096/29.9	.084/29.9	.070/29.9	.055/29.9	.038/28.6	.041/28.6	.021/11.2	.015/10.8	.012/10.5	.008/10.1	.006/ 9.8
	13	.085/29.9	.083/29.9	.076/29.9	.067/29.9	.056/29.9	.044/29.9	.031/28.6	.035/28.6	.021/13.4	.017/12.6	.013/12.1	.010/11.6	.008/11.6
	15	.067/29.9	.065/29.9	.060/29.9	.053/29.9	.044/29.9	.035/29.9	.026/28.6	.032/28.6	.022/13.4	.019/13.4	.015/13.4	.011/13.1	.010/13.1
	17	.054/29.9	.053/29.9	.049/29.9	.043/29.9	.036/29.9	.029/29.9	.022/28.6	.030/28.6	.024/17.5	.020/17.0	.016/16.5	.013/16.1	.011/16.1
	19	.045/29.9	.044/29.9	.041/29.9	.036/29.9	.031/29.9	.026/29.9	.021/28.6	.030/28.6	.025/19.0	.021/18.5	.018/18.5	.014/18.0	.013/18.0
	21	.038/29.9	.037/29.9	.035/29.9	.032/29.9	.028/29.9	.024/28.6	.020/28.6	.031/28.6	.026/20.9	.023/20.3	.018/19.6	.015/19.6	.013/19.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 30 - SHIP C, GM = 3 FT, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 3 FT (SPHERICAL TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.013/ 8.5	.014/ 8.5	.015/ 8.5	.016/ 8.5	.018/ 8.3	.019/ 8.3	.019/ 8.1	.019/ 7.9	.018/ 8.5	.017/ 8.5	.016/ 8.5	.015/ 8.7	.014/ 8.7
	9	.023/11.6	.023/11.2	.025/10.8	.027/ 9.5	.028/ 9.8	.030/10.1	.030/10.1	.030/10.1	.029/10.1	.028/ 9.5	.026/ 8.7	.025/ 8.7	.024/ 8.7
	11	.035/12.6	.035/12.6	.036/12.6	.036/12.1	.037/12.1	.038/11.6	.038/11.6	.038/11.6	.038/11.6	.038/12.1	.037/12.6	.037/12.6	.037/12.6
	13	.045/13.7	.045/13.7	.044/13.7	.043/13.4	.042/13.4	.042/12.8	.042/12.8	.042/12.8	.043/13.1	.044/13.4	.045/13.4	.046/13.7	.046/13.7
	15	.051/15.0	.050/15.0	.049/14.6	.046/14.6	.044/14.3	.042/14.3	.042/14.0	.043/14.0	.045/14.3	.047/14.6	.050/14.6	.051/14.6	.052/14.6
	17	.053/15.7	.052/15.7	.050/15.7	.047/15.7	.044/15.7	.041/15.3	.040/15.0	.041/15.0	.044/15.3	.047/15.7	.051/15.7	.053/15.7	.054/15.7
	19	.052/17.0	.051/17.0	.049/17.0	.046/17.0	.042/16.5	.039/16.1	.038/16.1	.039/16.1	.042/16.5	.046/16.5	.049/17.0	.052/17.0	.053/17.0
	21	.050/18.0	.049/18.0	.047/18.0	.043/18.0	.039/17.5	.036/17.5	.035/17.5	.036/17.5	.039/17.5	.043/17.5	.047/18.0	.049/18.0	.050/18.0
5	7	.014/10.5	.014/10.5	.015/ 9.5	.017/ 9.2	.018/ 9.2	.019/ 8.3	.019/ 8.1	.019/ 8.1	.018/ 7.5	.017/ 7.3	.015/ 7.3	.014/ 7.3	.014/ 7.3
	9	.023/10.8	.024/10.8	.025/10.5	.027/10.5	.029/10.5	.030/10.1	.030/ 9.8	.030/ 9.8	.029/ 9.8	.027/ 9.8	.026/10.1	.024/10.1	.024/10.1
	11	.034/14.3	.034/14.3	.035/14.3	.036/14.0	.037/13.4	.037/11.6	.038/11.2	.038/10.8	.038/10.8	.038/11.2	.037/11.2	.037/11.2	.037/11.2
	13	.044/15.3	.044/15.3	.043/15.3	.042/15.0	.042/14.6	.041/14.0	.041/12.8	.042/12.1	.043/12.1	.045/12.1	.046/12.1	.047/12.1	.047/12.6
	15	.050/16.5	.049/16.5	.048/16.5	.046/16.1	.044/15.7	.042/15.3	.042/14.3	.043/13.4	.045/13.4	.048/13.4	.050/13.4	.052/13.4	.053/13.4
	17	.052/17.5	.051/17.5	.049/17.5	.046/17.5	.043/17.0	.041/16.5	.040/15.3	.042/14.6	.045/14.3	.048/14.3	.051/14.3	.054/14.3	.054/14.3
	19	.051/18.5	.050/18.5	.048/18.5	.045/18.5	.041/18.0	.039/17.5	.038/16.5	.039/15.7	.043/15.3	.047/15.3	.050/15.3	.053/15.3	.053/15.7
	21	.049/19.6	.048/19.6	.046/19.6	.043/19.0	.039/19.0	.036/18.5	.035/17.5	.037/16.5	.040/16.5	.044/16.5	.047/16.5	.050/16.5	.051/16.5
10	7	.014/12.8	.014/12.8	.016/12.8	.017/12.8	.018/ 8.7	.019/ 8.7	.019/ 8.5	.019/ 8.5	.018/ 8.1	.016/ 6.3	.015/ 6.3	.014/ 6.3	.013/ 6.3
	9	.023/14.0	.023/14.0	.025/14.0	.027/13.7	.028/12.8	.029/11.2	.030/ 9.5	.029/ 9.2	.028/ 9.2	.027/ 9.2	.025/ 9.2	.024/ 9.2	.023/ 9.2
	11	.033/17.0	.034/17.0	.034/16.5	.035/16.5	.036/14.0	.037/14.0	.037/10.8	.038/10.5	.038/10.1	.037/10.1	.037/10.1	.037/10.1	.037/10.1
	13	.043/18.0	.043/17.5	.042/17.5	.042/17.5	.041/17.0	.041/16.1	.041/12.8	.042/11.2	.043/11.2	.045/11.2	.046/11.2	.047/11.2	.048/11.2
	15	.049/18.5	.048/18.5	.047/18.5	.045/18.5	.043/18.0	.042/17.5	.042/15.3	.043/12.8	.045/12.1	.048/12.1	.051/12.1	.053/12.1	.053/12.1
	17	.051/19.6	.050/19.6	.048/19.6	.045/19.0	.043/19.0	.041/18.0	.040/16.5	.042/14.0	.045/13.4	.049/13.4	.052/13.4	.054/13.4	.055/13.4
	19	.050/20.3	.050/20.3	.047/20.3	.044/20.3	.041/19.6	.038/19.0	.038/17.5	.040/15.3	.043/14.6	.047/14.3	.051/14.3	.053/14.3	.054/14.3
	21	.048/21.7	.048/21.7	.045/20.9	.042/20.9	.038/20.9	.036/20.3	.035/18.5	.037/16.5	.040/15.7	.044/15.3	.048/15.3	.051/15.3	.051/15.3
15	7	.013/17.5	.014/17.5	.015/14.3	.017/14.3	.018/10.1	.019/10.1	.019/10.1	.019/10.1	.017/10.1	.016/ 6.8	.014/ 5.7	.013/ 5.7	.013/ 5.7
	9	.022/20.3	.022/20.3	.024/20.3	.026/14.3	.028/14.3	.029/14.3	.029/10.1	.029/ 9.0	.028/ 8.7	.026/ 8.7	.024/ 8.7	.023/ 8.7	.022/ 8.7
	11	.032/20.3	.033/20.3	.033/20.3	.034/20.3	.035/20.3	.036/14.3	.037/10.1	.037/ 9.5	.037/ 9.5	.037/ 9.5	.036/ 9.5	.036/ 9.5	.036/ 9.5
	13	.042/20.9	.042/20.9	.041/20.9	.041/20.9	.040/20.3	.040/18.5	.041/10.5	.042/10.5	.043/10.5	.045/10.5	.046/10.5	.047/10.5	.047/10.5
	15	.048/21.7	.047/21.7	.046/21.7	.044/20.9	.042/20.9	.041/20.3	.041/19.0	.043/11.6	.045/11.2	.048/11.2	.051/11.2	.053/11.2	.054/11.2
	17	.050/22.4	.049/22.4	.047/22.4	.045/21.7	.042/21.7	.040/20.9	.040/19.6	.042/13.1	.045/12.6	.049/12.6	.052/12.6	.055/12.6	.056/12.6
	19	.050/23.3	.049/22.4	.047/22.4	.044/22.4	.040/22.4	.038/21.7	.038/20.3	.040/14.3	.043/13.7	.047/13.4	.051/13.4	.054/13.4	.055/13.4
	21	.048/23.3	.047/23.3	.045/23.3	.041/23.3	.038/23.3	.035/22.4	.035/20.9	.037/16.5	.040/14.6	.045/14.6	.048/14.6	.051/14.6	.052/14.6
20	7	.013/13.4	.014/13.4	.015/13.4	.017/13.4	.018/13.4	.019/13.4	.019/13.4	.018/13.4	.017/ 9.8	.016/ 6.4	.014/ 4.8	.013/ 4.8	.013/ 4.8
	9	.021/19.0	.022/19.0	.023/19.0	.025/19.0	.027/19.0	.028/19.0	.029/19.0	.028/ 8.7	.027/ 8.5	.025/ 8.3	.023/ 8.3	.022/ 8.1	.022/ 8.1
	11	.031/23.3	.032/23.3	.032/23.3	.033/23.3	.035/19.0	.035/19.0	.036/19.0	.036/ 9.2	.036/ 9.0	.036/ 9.0	.035/ 9.0	.035/ 9.0	.035/ 9.0
	13	.041/26.2	.041/23.3	.040/23.3	.040/23.3	.039/23.3	.039/23.3	.040/19.6	.041/ 9.8	.043/ 9.8	.044/ 9.8	.046/ 9.8	.046/ 9.8	.047/ 9.8
	15	.047/26.2	.046/26.2	.045/26.2	.043/26.2	.041/23.3	.041/23.3	.041/23.3	.043/10.8	.045/10.8	.048/10.5	.051/10.5	.053/10.5	.053/10.5
	17	.049/27.3	.048/27.3	.047/26.2	.044/26.2	.041/26.2	.040/23.3	.040/23.3	.042/11.6	.045/11.6	.049/11.6	.052/11.6	.055/11.6	.056/11.6
	19	.049/27.3	.048/27.3	.046/27.3	.043/27.3	.040/26.2	.038/26.2	.037/23.3	.040/13.4	.043/12.6	.047/12.6	.051/12.6	.054/12.6	.055/12.6
	21	.047/27.3	.046/27.3	.044/27.3	.041/27.3	.037/27.3	.035/26.2	.035/23.3	.037/15.3	.040/14.0	.045/13.7	.049/13.7	.051/13.4	.052/13.4

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 31 - SHIP C, GM = 3 FT, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 3 FT (SPHERICAL TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.026/ 8.5	.036/ 8.1	.056/ 7.7	.077/ 7.7	.094/ 7.5	.107/ 7.5	.112/ 7.5	.111/ 7.5	.103/ 7.3	.088/ 7.3	.069/ 7.3	.049/ 7.3	.038/ 7.3
	9	.045/10.1	.054/ 9.8	.075/ 9.5	.098/ 9.2	.118/ 9.2	.131/ 9.0	.137/ 9.0	.135/ 9.0	.124/ 9.0	.107/ 9.0	.085/ 9.2	.063/ 9.5	.052/10.1
	11	.057/11.2	.065/11.2	.084/10.8	.105/10.5	.123/10.5	.136/10.5	.141/10.5	.138/10.5	.127/10.5	.110/10.5	.090/10.8	.070/11.2	.060/11.2
	13	.061/12.1	.069/12.1	.084/11.6	.102/11.6	.119/11.6	.129/11.6	.134/11.6	.131/11.6	.121/11.6	.106/11.6	.087/12.1	.070/12.1	.063/12.1
	15	.060/13.1	.065/13.1	.079/12.8	.095/12.8	.109/12.6	.119/12.6	.123/12.6	.120/12.6	.111/12.6	.098/12.8	.082/12.8	.067/13.1	.061/13.1
	17	.056/14.3	.061/14.0	.073/14.0	.087/14.0	.099/13.7	.108/13.7	.111/13.7	.108/13.7	.101/13.7	.089/13.7	.075/14.0	.063/14.0	.057/14.3
	19	.052/15.0	.056/15.0	.066/15.0	.078/15.0	.089/14.6	.096/14.6	.099/15.0	.097/15.0	.091/15.0	.080/15.3	.068/15.7	.057/15.7	.053/15.7
	21	.047/15.7	.051/15.7	.060/15.7	.070/16.1	.080/16.1	.086/16.1	.089/16.5	.087/16.5	.081/16.5	.072/16.5	.061/16.5	.052/16.5	.048/16.5
5	7	.024/ 9.2	.034/ 8.3	.055/ 8.1	.076/ 7.7	.094/ 7.5	.107/ 7.3	.113/ 7.3	.113/ 7.3	.105/ 7.3	.090/ 7.1	.071/ 7.1	.051/ 6.8	.040/ 6.7
	9	.042/11.2	.052/10.8	.073/ 9.8	.097/ 9.5	.117/ 9.2	.132/ 9.0	.138/ 9.0	.136/ 8.7	.127/ 8.7	.110/ 8.7	.088/ 8.7	.065/ 8.7	.054/ 9.0
	11	.053/12.6	.062/12.1	.081/11.6	.103/11.2	.122/10.8	.135/10.5	.141/10.5	.139/10.1	.130/10.1	.113/10.1	.093/10.1	.073/10.1	.063/10.1
	13	.057/13.4	.064/13.4	.080/12.8	.100/12.6	.117/12.1	.129/11.6	.134/11.6	.132/11.2	.123/11.2	.109/11.2	.090/11.2	.073/11.2	.066/11.2
	15	.056/14.3	.062/14.3	.076/14.0	.092/13.7	.107/13.1	.118/12.8	.123/12.6	.121/12.6	.113/12.1	.100/12.1	.085/12.1	.070/12.1	.064/12.1
	17	.053/15.3	.058/15.0	.070/15.0	.084/14.6	.097/14.3	.107/14.0	.111/13.7	.109/13.4	.103/13.4	.091/13.1	.078/13.1	.065/13.1	.060/13.1
	19	.048/16.5	.053/16.1	.063/15.7	.076/15.7	.087/15.3	.096/15.3	.099/15.0	.098/14.6	.092/14.6	.082/14.3	.070/14.3	.060/14.0	.055/14.0
	21	.044/17.5	.048/17.5	.057/17.0	.068/17.0	.078/17.0	.085/16.5	.089/16.5	.088/16.1	.082/16.1	.074/16.1	.063/16.1	.054/15.7	.050/15.7
10	7	.022/11.6	.032/ 8.7	.053/ 8.3	.075/ 7.3	.094/ 7.1	.108/ 7.0	.114/ 7.0	.114/ 7.0	.106/ 7.0	.092/ 6.8	.073/ 6.8	.052/ 6.8	.041/ 6.8
	9	.039/12.8	.049/11.6	.071/10.8	.095/ 9.5	.116/ 8.7	.131/ 8.7	.139/ 8.7	.138/ 8.5	.129/ 8.3	.112/ 8.3	.090/ 8.3	.068/ 8.3	.056/ 8.3
	11	.050/14.3	.058/14.0	.077/12.8	.100/11.6	.120/11.2	.134/10.8	.142/10.1	.141/ 9.8	.132/ 9.5	.116/ 9.5	.095/ 9.5	.075/ 9.5	.066/ 9.5
	13	.053/15.3	.060/15.0	.077/14.3	.096/13.4	.114/12.6	.127/12.1	.134/11.6	.133/11.2	.125/10.8	.111/10.8	.093/10.5	.076/10.5	.068/10.5
	15	.052/16.1	.058/15.7	.072/15.3	.089/14.6	.105/14.0	.117/13.4	.123/12.8	.122/12.6	.115/12.1	.103/11.6	.087/11.6	.073/11.2	.066/11.2
	17	.049/17.0	.054/17.0	.066/16.1	.081/15.7	.095/15.3	.105/14.6	.111/14.3	.110/13.7	.104/13.1	.093/12.6	.080/12.6	.067/12.6	.062/12.1
	19	.045/18.0	.049/17.5	.060/17.0	.073/17.0	.086/16.1	.095/15.7	.099/15.3	.099/14.6	.093/14.3	.084/14.0	.072/13.7	.062/13.4	.057/13.4
	21	.041/18.5	.045/18.5	.054/18.0	.066/17.5	.077/17.5	.084/17.0	.088/16.5	.088/16.1	.084/15.7	.075/15.3	.065/15.3	.056/14.3	.052/14.3
15	7	.020/12.1	.031/10.1	.052/ 9.2	.075/ 6.8	.094/ 6.7	.108/ 6.7	.115/ 6.7	.115/ 6.7	.108/ 6.7	.094/ 6.7	.074/ 6.7	.053/ 6.5	.041/ 6.5
	9	.036/15.3	.046/12.6	.068/12.1	.093/ 9.5	.115/ 9.2	.131/ 8.5	.139/ 8.1	.139/ 7.9	.131/ 7.9	.114/ 7.7	.093/ 7.7	.070/ 7.7	.058/ 7.7
	11	.046/15.7	.054/15.7	.074/12.8	.097/12.8	.118/10.1	.134/10.1	.142/ 9.8	.142/ 9.5	.134/ 9.2	.118/ 9.0	.098/ 8.7	.077/ 8.7	.068/ 8.7
	13	.049/18.0	.056/18.0	.073/15.7	.093/13.4	.112/12.8	.126/12.6	.134/11.2	.134/10.5	.127/10.5	.113/10.1	.096/10.1	.078/ 9.8	.070/ 9.8
	15	.048/18.5	.054/18.0	.069/18.0	.086/15.7	.103/15.3	.116/13.4	.122/12.8	.123/12.1	.117/11.6	.105/11.2	.090/10.8	.075/10.8	.068/10.8
	17	.045/19.6	.050/19.6	.063/18.0	.079/17.5	.093/15.7	.104/15.3	.110/14.0	.111/13.4	.105/12.8	.095/12.1	.082/12.1	.070/11.6	.064/11.6
	19	.042/19.6	.046/19.6	.057/19.6	.071/18.0	.084/17.5	.093/16.5	.099/15.7	.099/15.0	.095/14.0	.086/13.4	.074/12.8	.064/12.6	.059/12.6
	21	.038/20.3	.042/20.3	.052/19.6	.064/18.5	.075/18.5	.084/18.0	.088/17.0	.089/16.1	.085/15.7	.077/15.0	.067/14.0	.057/13.7	.054/13.4
20	7	.019/13.7	.029/13.7	.051/13.7	.074/ 6.7	.094/ 6.7	.108/ 6.7	.115/ 6.5	.116/ 6.4	.108/ 6.4	.094/ 6.4	.075/ 6.3	.053/ 6.3	.042/ 6.3
	9	.033/19.0	.043/19.0	.066/14.3	.091/10.1	.114/ 7.9	.131/ 7.7	.139/ 7.7	.140/ 7.5	.132/ 7.5	.116/ 7.3	.094/ 7.3	.071/ 7.1	.059/ 7.1
	11	.041/19.0	.050/19.0	.070/19.0	.094/14.6	.116/10.8	.133/10.1	.142/ 9.8	.142/ 8.7	.135/ 8.5	.120/ 8.5	.100/ 8.3	.079/ 8.3	.069/ 8.3
	13	.044/19.0	.051/19.0	.069/19.0	.090/19.0	.110/14.6	.125/11.2	.134/10.8	.135/10.5	.128/10.1	.115/ 9.8	.098/ 9.5	.080/ 9.2	.072/ 9.0
	15	.043/23.3	.049/23.3	.065/19.0	.083/19.0	.101/15.0	.114/14.6	.122/12.1	.123/11.6	.118/11.2	.107/10.8	.091/10.5	.077/10.5	.070/10.1
	17	.041/23.3	.046/23.3	.060/19.0	.076/19.0	.091/19.0	.103/15.0	.110/14.6	.111/14.0	.107/12.1	.097/11.6	.084/11.2	.071/11.2	.066/10.8
	19	.038/23.3	.043/23.3	.054/23.3	.068/19.0	.082/19.0	.092/15.7	.099/15.3	.100/15.0	.096/14.3	.087/13.1	.076/12.6	.065/12.1	.061/12.1
	21	.035/23.3	.039/23.3	.049/23.3	.061/19.0	.073/19.0	.083/19.0	.088/16.5	.089/16.1	.086/15.3	.078/14.6	.068/13.7	.059/13.1	.055/12.8

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 32 - SHIP C, GM = 3 FT, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 3 FT (SPHERICAL TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.094/ 8.5	.101/ 8.5	.118/ 8.5	.139/ 8.5	.157/ 8.5	.170/ 8.5	.176/ 8.5	.173/ 8.5	.163/ 8.3	.146/ 8.3	.127/ 8.3	.111/ 8.3	.105/ 8.3
	9	.159/ 8.7	.170/ 8.7	.195/ 8.7	.224/ 9.0	.250/ 9.2	.268/ 9.2	.275/ 9.2	.271/ 9.2	.255/ 9.2	.231/ 9.2	.204/ 9.5	.182/ 9.5	.173/ 9.5
	11	.190/11.2	.198/11.2	.220/10.5	.246/10.1	.269/ 9.5	.286/ 9.5	.293/ 9.5	.288/ 9.5	.274/ 9.8	.253/ 9.8	.229/10.5	.210/10.8	.203/10.8
	13	.193/11.6	.200/11.6	.215/11.6	.235/10.8	.253/10.5	.265/10.1	.271/10.1	.268/10.1	.257/10.5	.240/10.8	.223/11.2	.209/11.6	.204/11.6
	15	.183/12.6	.187/12.6	.198/12.1	.212/11.6	.225/10.8	.235/10.5	.239/10.5	.236/10.5	.229/10.8	.217/11.6	.204/12.1	.194/12.1	.191/12.6
	17	.166/13.1	.169/13.1	.177/12.8	.187/12.1	.197/11.6	.204/10.8	.207/10.5	.206/10.8	.200/11.6	.191/12.1	.182/12.6	.175/12.8	.173/13.1
	19	.149/13.7	.151/13.4	.157/13.4	.164/12.8	.172/12.1	.177/11.2	.180/10.8	.178/11.2	.174/12.1	.168/12.6	.161/13.1	.156/13.4	.154/13.4
	21	.132/14.3	.134/14.3	.138/14.0	.144/13.4	.150/12.6	.154/11.6	.156/11.2	.155/11.6	.152/12.6	.147/13.1	.142/13.7	.138/14.0	.137/14.0
5	7	.089/ 9.5	.099/ 9.2	.120/ 9.0	.143/ 8.7	.163/ 8.3	.175/ 8.3	.180/ 8.3	.175/ 8.3	.162/ 8.3	.143/ 8.3	.121/ 8.1	.102/ 7.9	.095/ 7.5
	9	.128/ 9.5	.142/ 9.5	.173/ 9.5	.208/ 9.5	.241/ 9.2	.265/ 9.2	.278/ 9.2	.278/ 9.2	.267/ 9.0	.246/ 9.2	.222/ 9.2	.201/ 9.2	.194/ 9.2
	11	.146/13.1	.157/12.8	.185/ 9.8	.219/ 9.8	.252/ 9.5	.280/ 9.5	.298/ 9.5	.305/ 9.5	.301/ 9.5	.289/ 9.8	.274/ 9.8	.260/ 9.8	.255/ 9.8
	13	.147/13.7	.156/13.7	.177/13.4	.205/10.5	.234/ 9.8	.259/ 9.8	.277/ 9.8	.288/ 9.8	.290/10.1	.286/10.1	.278/10.1	.270/10.5	.268/10.5
	15	.140/14.6	.146/14.3	.162/14.3	.184/13.4	.207/10.5	.228/10.1	.245/10.1	.256/10.1	.261/10.5	.261/10.5	.258/10.8	.255/10.8	.253/10.8
	17	.128/15.0	.133/15.0	.145/15.0	.162/14.3	.180/13.1	.198/10.5	.213/10.5	.224/10.5	.230/10.5	.232/10.8	.231/10.8	.230/11.2	.229/11.2
	19	.116/15.7	.119/15.7	.129/15.3	.142/15.0	.157/14.0	.172/10.8	.185/10.5	.194/10.5	.200/10.8	.203/11.2	.204/11.2	.203/11.2	.203/11.6
	21	.104/16.5	.106/16.5	.114/16.1	.125/15.7	.137/14.6	.149/10.8	.160/10.8	.169/10.8	.174/10.8	.178/11.2	.179/11.6	.179/11.6	.179/11.6
10	7	.065/10.1	.080/10.1	.111/ 8.5	.140/ 8.5	.164/ 8.5	.178/ 8.5	.183/ 8.3	.178/ 8.3	.163/ 8.1	.140/ 8.1	.115/ 7.9	.094/ 7.9	.086/ 7.9
	9	.093/10.5	.111/10.5	.149/ 9.8	.191/ 8.7	.230/ 8.7	.259/ 8.7	.277/ 8.7	.281/ 8.7	.273/ 8.7	.254/ 8.7	.230/ 8.7	.210/ 8.7	.202/ 8.7
	11	.106/15.7	.120/15.7	.155/10.5	.196/ 9.8	.238/ 9.5	.276/ 9.5	.304/ 9.2	.321/ 9.2	.327/ 9.2	.323/ 9.2	.314/ 9.2	.304/ 9.2	.300/ 9.2
	13	.108/16.5	.119/16.1	.146/16.1	.182/10.5	.220/ 9.8	.257/ 9.5	.289/ 9.5	.312/ 9.5	.327/ 9.5	.333/ 9.5	.334/ 9.8	.333/ 9.8	.332/ 9.8
	15	.104/17.0	.112/17.0	.133/16.5	.162/10.8	.194/10.1	.228/ 9.8	.258/ 9.8	.282/ 9.8	.300/ 9.8	.311/ 9.8	.317/ 9.8	.320/ 9.8	.321/ 9.8
	17	.097/17.5	.103/17.5	.119/17.5	.142/16.5	.170/10.5	.198/ 9.8	.225/ 9.8	.248/ 9.8	.266/ 9.8	.278/ 9.8	.286/10.1	.291/10.1	.292/10.1
	19	.089/18.5	.093/18.0	.106/18.0	.125/17.5	.147/10.5	.172/10.1	.195/ 9.8	.216/ 9.8	.232/10.1	.245/10.1	.253/10.1	.258/10.1	.259/10.1
	21	.080/19.0	.084/19.0	.094/18.5	.110/18.0	.129/17.0	.149/10.1	.169/10.1	.187/10.1	.203/10.1	.214/10.1	.222/10.1	.226/10.5	.228/10.5
15	7	.056/ 8.7	.077/ 8.5	.112/ 8.5	.144/ 8.5	.169/ 8.5	.184/ 8.5	.189/ 8.5	.182/ 8.3	.165/ 8.3	.140/ 8.3	.112/ 7.9	.089/ 7.7	.081/ 7.5
	9	.073/12.1	.095/ 9.2	.137/ 9.2	.183/ 9.2	.224/ 8.7	.257/ 8.7	.277/ 8.5	.284/ 8.5	.276/ 8.5	.258/ 8.5	.233/ 8.5	.211/ 8.5	.202/ 8.5
	11	.080/20.3	.097/12.6	.136/ 9.5	.184/ 9.2	.232/ 9.2	.277/ 9.0	.313/ 9.0	.338/ 9.0	.350/ 9.0	.352/ 9.0	.345/ 9.0	.338/ 9.0	.335/ 9.0
	13	.081/20.3	.094/20.3	.126/12.6	.168/ 9.2	.215/ 9.2	.262/ 9.2	.304/ 9.2	.339/ 9.2	.364/ 9.2	.380/ 9.2	.387/ 9.2	.390/ 9.2	.391/ 9.2
	15	.079/20.3	.088/20.3	.113/20.3	.148/ 9.5	.190/ 9.2	.233/ 9.2	.275/ 9.2	.312/ 9.2	.341/ 9.2	.363/ 9.5	.377/ 9.5	.384/ 9.5	.387/ 9.5
	17	.074/20.9	.081/20.9	.101/20.9	.130/ 9.5	.165/ 9.5	.204/ 9.2	.242/ 9.5	.276/ 9.5	.305/ 9.5	.328/ 9.5	.344/ 9.5	.353/ 9.5	.356/ 9.5
	19	.068/21.7	.074/21.7	.090/20.9	.114/20.3	.144/ 9.5	.177/ 9.5	.210/ 9.5	.241/ 9.5	.268/ 9.5	.290/ 9.5	.305/ 9.5	.315/ 9.5	.318/ 9.5
	21	.062/21.7	.067/21.7	.080/21.7	.100/20.9	.125/ 9.5	.153/ 9.5	.182/ 9.5	.210/ 9.5	.234/ 9.5	.254/ 9.5	.268/ 9.8	.277/ 9.8	.280/ 9.8
20	7	.052/ 9.0	.073/ 9.0	.109/ 9.0	.142/ 9.0	.167/ 9.0	.183/ 9.0	.187/ 9.0	.180/ 9.0	.164/ 9.0	.139/ 7.7	.110/ 7.7	.086/ 7.5	.078/ 5.2
	9	.061/14.0	.083/ 9.5	.128/ 9.2	.175/ 9.0	.218/ 9.0	.252/ 9.0	.274/ 8.7	.282/ 8.5	.275/ 8.3	.257/ 8.3	.230/ 8.3	.207/ 8.3	.197/ 8.3
	11	.063/19.0	.082/19.0	.123/ 9.2	.175/ 9.0	.229/ 9.0	.280/ 9.0	.322/ 8.7	.352/ 8.7	.368/ 8.7	.372/ 8.7	.367/ 8.7	.360/ 8.7	.357/ 8.5
	13	.062/23.3	.077/23.3	.112/ 9.8	.160/ 9.0	.214/ 9.0	.270/ 9.0	.322/ 9.0	.365/ 9.0	.399/ 9.0	.421/ 9.0	.433/ 9.0	.439/ 9.0	.440/ 9.0
	15	.060/23.3	.071/23.3	.100/23.3	.141/ 9.2	.190/ 9.0	.243/ 9.0	.295/ 9.0	.343/ 9.0	.382/ 9.0	.412/ 9.0	.433/ 9.0	.445/ 9.0	.449/ 9.0
	17	.057/26.2	.065/26.2	.088/23.3	.123/ 9.2	.166/ 9.0	.213/ 9.0	.261/ 9.0	.307/ 9.0	.346/ 9.0	.378/ 9.0	.400/ 9.0	.414/ 9.0	.419/ 9.0
	19	.053/26.2	.060/26.2	.078/26.2	.107/ 9.2	.144/ 9.0	.185/ 9.0	.228/ 9.0	.269/ 9.0	.306/ 9.2	.336/ 9.2	.358/ 9.2	.371/ 9.2	.376/ 9.2
	21	.049/27.3	.054/27.3	.070/26.2	.094/23.3	.125/ 9.2	.161/ 9.0	.198/ 9.0	.235/ 9.2	.267/ 9.2	.295/ 9.2	.315/ 9.2	.328/ 9.2	.332/ 9.2

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 33 - SHIP C, GM = 4 FT, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 4 FT (SPHERICAL TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.006/ 7.9	.006/ 7.9	.008/ 7.9	.009/ 7.9	.011/ 7.7	.012/ 7.7	.012/ 7.7	.012/ 7.7	.011/ 7.7	.009/ 7.9	.008/ 7.9	.006/ 7.9	.006/ 7.9
	9	.007/ 8.5	.008/ 8.7	.010/ 8.7	.012/ 9.0	.014/ 9.2	.016/ 9.5	.016/ 9.5	.016/ 9.5	.014/ 9.2	.013/ 9.0	.010/ 8.7	.008/ 8.7	.007/ 8.7
	11	.007/ 8.7	.009/ 8.7	.011/11.6	.014/11.2	.017/11.2	.018/11.6	.019/11.6	.018/11.6	.017/11.6	.014/11.6	.012/11.6	.009/ 8.7	.008/ 8.7
	13	.008/14.3	.009/14.3	.012/13.7	.015/13.1	.018/13.1	.020/13.1	.020/13.1	.020/13.1	.018/13.1	.016/13.1	.012/13.4	.009/13.7	.008/14.0
	15	.009/17.0	.010/15.7	.013/15.3	.016/15.3	.019/15.0	.021/15.0	.022/15.7	.021/15.7	.020/16.1	.017/16.5	.014/17.0	.011/17.5	.009/17.5
	17	.010/18.5	.011/18.5	.014/18.0	.018/18.0	.021/18.0	.023/18.0	.024/18.5	.024/18.5	.022/18.5	.019/19.0	.016/19.0	.013/19.6	.011/19.6
	19	.013/25.1	.015/25.1	.018/25.1	.022/25.1	.025/25.1	.028/25.1	.029/25.1	.028/25.1	.026/25.1	.023/25.1	.019/25.1	.016/25.1	.014/25.1
	21	.016/25.1	.018/25.1	.021/25.1	.026/25.1	.030/25.1	.032/25.1	.034/25.1	.033/25.1	.031/25.1	.027/25.1	.023/25.1	.019/25.1	.017/25.1
5	7	.009/ 9.5	.009/ 9.5	.010/ 9.2	.011/ 9.2	.012/ 9.0	.012/ 7.9	.012/ 7.7	.011/ 7.7	.010/ 7.7	.009/ 7.5	.007/ 7.0	.005/ 6.8	.004/ 6.7
	9	.010/ 9.5	.011/ 9.5	.012/ 9.5	.014/ 9.5	.015/ 9.5	.016/ 9.5	.016/ 9.5	.015/ 9.5	.014/ 9.5	.012/ 9.5	.009/ 9.2	.007/ 7.5	.006/ 7.5
	11	.009/10.5	.010/10.5	.012/10.5	.015/10.5	.017/10.8	.018/11.2	.019/11.2	.018/11.2	.016/11.2	.014/11.2	.011/11.6	.008/11.6	.007/11.6
	13	.009/10.5	.010/10.5	.013/14.3	.016/13.1	.018/13.1	.020/13.1	.020/13.1	.020/12.8	.018/12.8	.016/12.8	.012/13.1	.009/13.1	.008/13.4
	15	.009/17.5	.010/17.5	.013/17.0	.016/15.3	.019/15.3	.021/15.3	.022/15.3	.021/15.3	.020/15.7	.017/15.7	.014/16.1	.011/16.5	.009/16.5
	17	.011/26.2	.012/26.2	.015/18.5	.018/18.5	.021/18.5	.023/18.5	.024/18.0	.024/18.5	.022/18.5	.019/18.5	.016/18.5	.012/18.5	.011/18.5
	19	.017/26.2	.018/26.2	.021/26.2	.024/25.1	.027/25.1	.028/25.1	.029/24.2	.028/23.3	.025/23.3	.022/23.3	.018/21.7	.014/21.7	.013/21.7
	21	.023/26.2	.024/26.2	.027/26.2	.031/25.1	.033/25.1	.035/25.1	.035/25.1	.033/24.2	.031/24.2	.027/23.3	.022/23.3	.018/23.3	.017/23.3
10	7	.014/12.8	.014/12.8	.014/12.8	.014/12.8	.015/12.8	.014/12.8	.013/10.5	.012/ 7.7	.010/ 7.7	.008/ 7.5	.006/ 7.3	.004/ 6.4	.004/ 6.3
	9	.016/12.8	.016/12.8	.016/12.8	.017/12.8	.018/12.8	.018/10.8	.017/10.8	.016/ 9.8	.014/ 9.5	.012/ 9.2	.009/ 9.2	.006/ 9.2	.005/ 6.5
	11	.014/12.8	.014/12.8	.015/12.8	.017/12.8	.018/12.8	.019/12.8	.019/11.2	.018/11.2	.016/11.2	.014/11.2	.011/11.2	.008/11.2	.006/11.2
	13	.012/12.8	.013/12.8	.014/12.8	.017/12.8	.019/12.8	.020/12.8	.021/12.8	.020/12.8	.018/12.8	.015/12.6	.012/12.6	.009/12.6	.008/12.8
	15	.011/12.8	.012/12.8	.014/12.8	.017/12.8	.019/12.8	.021/14.3	.022/14.6	.021/14.6	.020/14.3	.017/14.3	.014/14.0	.010/14.0	.009/14.0
	17	.011/26.2	.013/26.2	.015/26.2	.018/18.5	.021/18.5	.023/18.0	.024/18.0	.023/18.0	.022/18.0	.019/18.0	.015/18.0	.012/18.0	.011/18.0
	19	.015/26.2	.016/26.2	.020/26.2	.024/26.2	.027/25.1	.028/25.1	.029/25.1	.028/22.4	.025/22.4	.022/21.7	.018/20.9	.014/20.3	.013/20.3
	21	.019/26.2	.021/26.2	.025/26.2	.029/26.2	.033/25.1	.035/25.1	.035/25.1	.034/25.1	.031/22.4	.026/22.4	.021/22.4	.017/22.4	.016/22.4
15	7	.037/23.3	.036/23.3	.034/23.3	.030/17.5	.025/17.5	.020/17.5	.015/14.3	.014/14.3	.011/14.3	.008/ 7.3	.006/ 7.3	.004/ 7.1	.003/ 5.2
	9	.035/17.5	.034/17.5	.032/17.5	.029/17.5	.024/17.5	.020/17.5	.016/17.5	.017/14.3	.014/14.3	.011/ 9.0	.009/ 9.0	.006/ 9.0	.005/ 8.7
	11	.028/17.5	.028/17.5	.026/17.5	.024/17.5	.021/17.5	.019/17.5	.016/14.3	.019/14.3	.016/10.8	.014/10.8	.011/10.8	.007/10.5	.006/10.5
	13	.023/17.5	.022/17.5	.021/17.5	.020/17.5	.019/17.5	.018/17.5	.016/14.3	.020/14.3	.018/12.6	.015/12.6	.012/12.6	.009/12.1	.007/12.1
	15	.019/17.5	.019/17.5	.019/17.5	.018/17.5	.018/17.5	.017/17.5	.017/14.3	.021/14.3	.020/14.3	.017/14.0	.014/13.7	.010/13.4	.009/13.4
	17	.019/27.3	.019/27.3	.019/27.3	.019/27.3	.019/27.3	.019/26.2	.018/17.5	.024/17.5	.022/17.5	.019/17.5	.015/17.5	.012/17.0	.011/17.0
	19	.020/27.3	.020/27.3	.021/27.3	.021/27.3	.022/27.3	.022/26.2	.021/26.2	.028/26.2	.025/20.9	.021/20.9	.017/20.3	.014/19.6	.012/19.6
	21	.021/27.3	.021/27.3	.022/27.3	.024/27.3	.025/26.2	.026/26.2	.025/26.2	.033/26.2	.030/25.1	.026/21.7	.021/20.9	.017/20.9	.015/20.9
20	7	.074/28.6	.073/28.6	.069/28.6	.064/28.6	.058/28.6	.049/28.6	.037/28.6	.044/28.6	.021/21.7	.008/20.3	.006/ 7.9	.004/ 7.1	.003/ 4.8
	9	.096/27.3	.094/27.3	.088/27.3	.080/27.3	.070/26.2	.058/26.2	.042/26.2	.047/26.2	.021/20.9	.011/ 8.7	.009/ 8.7	.006/ 8.7	.004/ 8.3
	11	.086/26.2	.084/26.2	.079/26.2	.071/26.2	.061/26.2	.050/26.2	.037/26.2	.041/25.1	.020/19.6	.014/10.8	.010/10.5	.007/10.1	.006/ 9.8
	13	.073/26.2	.071/26.2	.067/26.2	.060/26.2	.051/26.2	.042/26.2	.031/26.2	.035/25.1	.020/13.4	.015/12.1	.012/12.1	.009/11.6	.007/11.6
	15	.064/26.2	.062/26.2	.058/26.2	.052/26.2	.044/26.2	.036/26.2	.026/26.2	.032/26.2	.021/13.4	.017/13.4	.013/13.1	.010/13.1	.009/13.1
	17	.057/26.2	.056/26.2	.052/26.2	.046/26.2	.039/26.2	.032/26.2	.024/26.2	.031/26.2	.022/19.0	.018/17.5	.015/17.0	.012/16.5	.010/16.1
	19	.051/26.2	.050/26.2	.047/26.2	.042/26.2	.036/26.2	.030/26.2	.024/26.2	.033/26.2	.025/26.2	.021/19.0	.017/19.0	.013/19.0	.012/19.0
	21	.045/27.3	.044/27.3	.042/27.3	.038/26.2	.034/26.2	.029/26.2	.024/26.2	.036/26.2	.030/25.1	.025/20.9	.020/20.3	.016/20.3	.014/19.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 34 - SHIP C, GM = 4 FT, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 4 FT (SPHERICAL TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.013/ 8.5	.014/ 8.5	.015/ 8.5	.017/ 8.5	.018/ 8.3	.019/ 8.1	.019/ 7.9	.019/ 7.9	.018/ 8.3	.017/ 8.5	.016/ 8.5	.015/ 8.7	.014/ 8.7
	9	.023/ 8.7	.023/ 8.7	.025/ 9.0	.027/ 9.5	.028/ 9.8	.030/10.1	.030/10.1	.030/10.1	.029/10.1	.028/ 9.5	.026/ 8.7	.025/ 8.7	.024/ 8.7
	11	.034/12.6	.035/12.6	.035/12.6	.036/12.1	.037/12.1	.037/11.6	.038/11.6	.038/11.6	.038/11.6	.037/12.1	.037/12.6	.036/12.6	.036/12.6
	13	.045/13.7	.044/13.7	.044/13.7	.043/13.4	.042/13.4	.041/12.8	.041/12.8	.042/12.8	.043/13.1	.044/13.4	.045/13.7	.046/13.7	.046/13.7
	15	.050/15.0	.050/15.0	.048/14.6	.046/14.6	.044/14.3	.042/14.3	.041/14.0	.042/14.0	.044/14.3	.047/14.6	.049/14.6	.051/14.6	.051/14.6
	17	.052/15.7	.052/15.7	.050/15.7	.047/15.7	.043/15.7	.041/15.3	.040/15.0	.041/15.3	.044/15.3	.047/15.7	.050/15.7	.052/15.7	.053/15.7
	19	.052/17.0	.051/17.0	.049/17.0	.045/17.0	.042/16.5	.039/16.1	.038/16.1	.039/16.1	.042/16.5	.046/16.5	.049/17.0	.051/17.0	.052/17.0
	21	.049/18.0	.049/18.0	.046/18.0	.043/18.0	.039/17.5	.036/17.5	.035/17.5	.036/17.5	.039/17.5	.043/18.0	.047/18.0	.049/18.0	.050/18.0
5	7	.014/10.5	.014/10.5	.015/ 9.2	.017/ 9.2	.018/ 9.2	.019/ 8.3	.019/ 8.1	.019/ 8.1	.018/ 7.5	.017/ 7.3	.015/ 7.3	.014/ 7.3	.014/ 7.3
	9	.023/10.8	.024/10.8	.025/10.5	.027/10.5	.028/10.5	.030/10.1	.030/ 9.8	.030/ 9.8	.029/ 9.8	.027/ 9.8	.026/10.1	.024/10.1	.024/10.1
	11	.034/14.3	.034/14.3	.035/14.3	.036/14.0	.036/13.4	.037/11.6	.038/11.2	.038/10.8	.038/10.8	.037/11.2	.037/11.2	.037/11.2	.036/11.2
	13	.044/15.3	.043/15.3	.043/15.3	.042/15.0	.041/14.6	.041/14.0	.041/12.8	.042/12.1	.043/12.1	.044/12.1	.046/12.1	.046/12.1	.047/12.6
	15	.049/16.5	.049/16.5	.047/16.5	.045/16.1	.043/15.7	.042/15.3	.041/14.3	.043/13.4	.045/13.4	.047/13.4	.050/13.4	.052/13.4	.052/13.4
	17	.051/17.5	.051/17.5	.049/17.5	.046/17.5	.043/17.0	.041/16.5	.040/15.3	.041/14.6	.044/14.3	.048/14.3	.051/14.3	.053/14.6	.054/14.6
	19	.051/18.5	.050/18.5	.048/18.5	.045/18.5	.041/18.0	.039/17.5	.038/16.5	.039/15.7	.042/15.3	.046/15.3	.050/15.3	.052/15.7	.053/15.7
	21	.049/19.6	.048/19.6	.046/19.6	.042/19.6	.039/19.0	.036/18.5	.035/17.5	.036/17.0	.039/16.5	.043/16.5	.047/16.5	.050/16.5	.050/16.5
10	7	.014/12.8	.014/12.8	.016/12.8	.017/12.8	.018/ 8.7	.019/ 8.7	.019/ 8.5	.019/ 8.3	.018/ 8.1	.016/ 6.3	.015/ 6.3	.014/ 6.3	.014/ 6.3
	9	.023/14.0	.023/14.0	.025/14.0	.026/13.7	.028/12.8	.029/11.2	.030/ 9.5	.029/ 9.2	.028/ 9.2	.027/ 9.2	.025/ 9.2	.024/ 9.2	.023/ 9.2
	11	.033/17.0	.033/17.0	.034/16.5	.035/16.5	.036/14.0	.037/14.0	.037/10.8	.037/10.5	.037/10.1	.037/10.1	.037/10.1	.036/10.1	.036/10.5
	13	.043/18.0	.042/17.5	.042/17.5	.041/17.5	.041/17.0	.040/16.1	.041/12.8	.042/11.6	.043/11.2	.044/11.2	.046/11.2	.047/11.2	.047/11.2
	15	.048/18.5	.048/18.5	.046/18.5	.045/18.5	.043/18.0	.041/17.5	.041/15.3	.043/12.8	.045/12.6	.048/12.1	.050/12.1	.052/12.1	.053/12.6
	17	.051/19.6	.050/19.6	.048/19.6	.045/19.0	.042/19.0	.040/18.0	.040/16.5	.041/14.3	.044/13.7	.048/13.4	.051/13.4	.054/13.4	.055/13.4
	19	.050/20.3	.049/20.3	.047/20.3	.044/20.3	.041/19.6	.038/19.0	.038/17.5	.039/15.3	.043/14.6	.047/14.3	.050/14.3	.053/14.3	.054/14.3
	21	.048/21.7	.047/21.7	.045/21.7	.042/20.9	.038/20.9	.035/20.3	.035/18.5	.036/16.5	.040/15.7	.044/15.3	.048/15.3	.050/15.3	.051/15.7
15	7	.013/17.5	.014/17.5	.015/14.3	.017/14.3	.018/10.1	.019/10.1	.019/10.1	.019/10.1	.018/10.1	.016/ 6.8	.015/ 5.7	.014/ 5.7	.013/ 5.7
	9	.022/20.3	.022/20.3	.024/20.3	.026/14.3	.028/14.3	.029/14.3	.029/10.1	.029/ 9.0	.028/ 8.7	.026/ 8.7	.024/ 8.5	.023/ 8.5	.023/ 8.7
	11	.032/20.3	.032/20.3	.033/20.3	.034/20.3	.035/20.3	.036/14.3	.037/10.1	.037/ 9.5	.037/ 9.5	.036/ 9.5	.036/ 9.5	.036/ 9.5	.036/ 9.5
	13	.042/20.9	.041/20.9	.041/20.9	.040/20.9	.040/20.3	.040/18.5	.040/17.5	.041/10.5	.043/10.5	.044/10.5	.046/10.5	.047/10.5	.047/10.5
	15	.047/21.7	.047/21.7	.046/21.7	.044/20.9	.042/20.9	.041/20.3	.041/19.0	.042/11.6	.045/11.2	.048/11.2	.051/11.2	.052/11.2	.053/11.2
	17	.050/22.4	.049/22.4	.047/22.4	.044/21.7	.042/21.7	.040/20.9	.040/19.6	.041/13.1	.045/12.6	.048/12.6	.052/12.6	.054/12.6	.055/12.6
	19	.049/23.3	.049/22.4	.047/22.4	.043/22.4	.040/22.4	.038/21.7	.037/20.3	.039/14.3	.043/13.7	.047/13.4	.051/13.4	.053/13.4	.054/13.4
	21	.047/23.3	.047/23.3	.044/23.3	.041/23.3	.038/23.3	.035/22.4	.035/20.9	.036/16.5	.040/15.0	.044/14.6	.048/14.6	.051/14.6	.051/14.6
20	7	.013/13.4	.013/13.4	.015/13.4	.017/13.4	.018/13.4	.019/13.4	.019/13.4	.019/13.4	.017/ 9.8	.016/ 6.4	.014/ 4.8	.013/ 4.8	.013/ 4.8
	9	.021/19.0	.022/19.0	.023/19.0	.025/19.0	.027/19.0	.028/19.0	.029/19.0	.028/ 8.5	.027/ 8.3	.025/ 8.1	.024/ 8.1	.022/ 8.1	.022/ 8.1
	11	.031/23.3	.031/23.3	.032/23.3	.033/23.3	.034/19.0	.035/19.0	.036/19.0	.036/ 9.2	.036/ 9.0	.036/ 9.0	.035/ 9.0	.035/ 9.0	.035/ 9.0
	13	.041/26.2	.041/23.3	.040/23.3	.040/23.3	.039/23.3	.039/23.3	.040/19.6	.041/ 9.8	.042/ 9.8	.044/ 9.8	.045/ 9.8	.046/ 9.8	.046/ 9.8
	15	.047/26.2	.046/26.2	.045/26.2	.043/26.2	.041/23.3	.040/23.3	.041/23.3	.042/10.8	.045/10.8	.048/10.8	.050/10.5	.052/10.5	.053/10.5
	17	.049/27.3	.048/27.3	.046/26.2	.044/26.2	.041/26.2	.039/23.3	.039/23.3	.041/11.6	.045/11.6	.048/11.6	.052/11.6	.054/11.6	.055/11.6
	19	.049/27.3	.048/27.3	.046/27.3	.043/27.3	.040/26.2	.037/26.2	.037/23.3	.039/13.4	.043/12.6	.047/12.6	.051/12.6	.053/12.6	.054/12.6
	21	.047/27.3	.046/27.3	.044/27.3	.041/27.3	.037/27.3	.035/26.2	.034/23.3	.036/15.3	.040/14.0	.044/13.7	.048/13.7	.051/13.7	.052/13.7

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 35 - SHIP C, GM = 4 FT, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 4 FT (SPHERICAL TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)

CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.026/ 8.5	.036/ 8.1	.056/ 7.7	.076/ 7.7	.094/ 7.5	.106/ 7.5	.112/ 7.5	.111/ 7.5	.103/ 7.3	.088/ 7.3	.069/ 7.3	.049/ 7.3	.038/ 7.3
	9	.045/10.1	.054/ 9.8	.075/ 9.5	.098/ 9.2	.118/ 9.2	.131/ 9.0	.137/ 9.0	.135/ 9.0	.124/ 9.0	.107/ 9.0	.085/ 9.2	.063/ 9.5	.051/10.1
	11	.057/11.2	.065/11.2	.084/10.8	.105/10.5	.123/10.5	.136/10.5	.141/10.5	.138/10.5	.127/10.5	.110/10.5	.089/10.8	.069/11.2	.060/11.2
	13	.061/12.1	.068/12.1	.084/11.6	.102/11.6	.118/11.6	.129/11.6	.134/11.6	.131/11.6	.121/11.6	.106/11.6	.087/12.1	.070/12.1	.063/12.1
	15	.060/13.1	.065/13.1	.079/12.8	.095/12.8	.109/12.6	.119/12.6	.123/12.6	.120/12.6	.111/12.6	.098/12.8	.082/12.8	.067/13.1	.061/13.1
	17	.056/14.3	.061/14.0	.073/14.0	.087/14.0	.099/13.7	.107/13.7	.111/13.7	.108/13.7	.101/13.7	.089/13.7	.075/14.0	.063/14.0	.057/14.3
	19	.052/15.0	.056/15.0	.066/15.0	.078/15.0	.089/14.6	.096/14.6	.099/15.0	.097/15.0	.090/15.0	.080/15.3	.068/15.7	.057/15.7	.053/15.7
	21	.047/15.7	.051/15.7	.060/15.7	.070/16.1	.080/16.1	.086/16.1	.089/16.5	.087/16.5	.081/16.5	.072/16.5	.061/16.5	.052/16.5	.048/16.5
5	7	.024/ 9.2	.034/ 8.3	.054/ 8.1	.076/ 7.7	.094/ 7.5	.107/ 7.3	.113/ 7.3	.112/ 7.3	.104/ 7.3	.090/ 7.1	.071/ 7.1	.051/ 6.8	.040/ 6.7
	9	.042/11.2	.052/10.8	.073/ 9.8	.097/ 9.5	.117/ 9.2	.131/ 9.0	.138/ 9.0	.136/ 8.7	.127/ 8.7	.110/ 8.7	.088/ 8.7	.065/ 8.7	.054/ 9.0
	11	.053/12.6	.062/12.1	.081/11.6	.103/11.2	.122/10.8	.135/10.5	.141/10.5	.139/10.1	.130/10.1	.113/10.1	.093/10.1	.072/10.1	.063/10.1
	13	.057/13.4	.064/13.4	.080/12.8	.099/12.6	.116/12.1	.128/11.6	.134/11.6	.132/11.2	.123/11.2	.109/11.2	.090/11.2	.073/11.2	.066/11.2
	15	.056/14.3	.062/14.3	.076/14.0	.092/13.7	.107/13.4	.118/12.8	.123/12.6	.121/12.6	.113/12.1	.100/12.1	.085/12.1	.070/12.1	.064/12.1
	17	.053/15.3	.058/15.0	.070/15.0	.084/14.6	.097/14.3	.106/14.0	.111/13.7	.109/13.4	.102/13.4	.091/13.1	.078/13.1	.065/13.1	.060/13.1
	19	.048/16.5	.053/16.1	.063/15.7	.076/15.7	.087/15.3	.095/15.3	.099/15.0	.098/14.6	.092/14.6	.082/14.3	.070/14.3	.060/14.0	.055/14.0
	21	.044/17.5	.048/17.5	.057/17.0	.068/17.0	.078/17.0	.085/16.5	.089/16.5	.087/16.1	.082/16.1	.074/16.1	.063/16.1	.054/15.7	.050/15.7
10	7	.022/11.6	.032/ 8.7	.053/ 8.3	.075/ 7.3	.094/ 7.1	.107/ 7.0	.114/ 7.0	.114/ 7.0	.106/ 7.0	.092/ 6.8	.073/ 6.8	.052/ 6.8	.041/ 6.8
	9	.039/12.8	.049/11.6	.071/10.8	.095/ 9.5	.116/ 8.7	.131/ 8.7	.139/ 8.7	.138/ 8.5	.128/ 8.3	.112/ 8.3	.090/ 8.3	.068/ 8.3	.056/ 8.3
	11	.050/14.3	.058/14.0	.077/12.8	.100/11.6	.120/11.2	.134/10.8	.141/10.1	.140/ 9.8	.132/ 9.5	.116/ 9.5	.095/ 9.5	.075/ 9.5	.065/ 9.5
	13	.053/15.3	.060/15.0	.077/14.3	.096/13.4	.114/12.6	.127/12.1	.134/11.6	.133/11.2	.125/10.8	.111/10.8	.093/10.5	.076/10.5	.068/10.5
	15	.052/16.1	.058/15.7	.072/15.3	.089/14.6	.105/14.0	.117/13.4	.122/12.8	.122/12.6	.115/12.1	.103/11.6	.087/11.6	.073/11.2	.066/11.2
	17	.049/17.0	.054/17.0	.066/16.1	.081/15.7	.095/15.3	.105/14.6	.110/14.3	.110/13.7	.104/13.1	.093/12.6	.080/12.6	.067/12.6	.062/12.1
	19	.045/18.0	.049/17.5	.060/17.0	.073/17.0	.085/16.1	.094/15.7	.099/15.3	.099/14.6	.093/14.3	.084/14.0	.072/13.7	.062/13.4	.057/13.4
	21	.041/18.5	.045/18.5	.054/18.0	.066/17.5	.076/17.5	.084/17.0	.088/16.5	.088/16.1	.083/15.7	.075/15.3	.065/15.3	.056/14.3	.052/14.3
15	7	.020/12.1	.031/10.1	.052/ 9.2	.074/ 6.8	.094/ 6.7	.108/ 6.7	.115/ 6.7	.115/ 6.7	.107/ 6.7	.093/ 6.7	.074/ 6.7	.053/ 6.5	.041/ 6.5
	9	.036/15.3	[illegible]/12.6	.068/12.1	.093/ 9.5	.115/ 9.2	.131/ 8.5	.139/ 8.1	.139/ 7.9	.130/ 7.9	.114/ 7.7	.092/ 7.7	.070/ 7.7	.058/ 7.7
	11	.046/15.7	[illegible]5.7	.074/12.8	.097/12.8	.118/10.1	.133/10.1	.142/ 9.8	.141/ 9.5	.133/ 9.2	.118/ 9.0	.098/ 8.7	.077/ 8.7	.068/ 8.7
	13	.049/18.0	.056/18.0	.073/15.7	.093/13.4	.112/12.8	.126/12.6	.134/11.2	.134/10.8	.127/10.5	.113/10.1	.095/10.1	.078/ 9.8	.070/ 9.8
	15	.048/18.5	.054/18.0	.069/18.0	.086/15.7	.103/15.3	.115/13.4	.122/12.8	.123/12.1	.116/11.6	.105/11.2	.089/10.8	.075/10.8	.068/10.8
	17	.045/19.6	.050/19.6	.063/18.0	.079/17.5	.093/15.7	.104/15.3	.110/14.0	.111/13.4	.105/12.8	.095/12.1	.082/12.1	.069/11.6	.064/11.6
	19	.042/19.6	.046/19.6	.057/19.6	.071/18.0	.084/17.5	.093/16.5	.099/15.7	.099/15.0	.095/14.0	.086/13.4	.074/12.8	.063/12.6	.059/12.6
	21	.038/20.3	.042/20.3	.052/19.6	.064/18.5	.075/18.5	.083/18.0	.088/17.0	.089/16.1	.085/15.7	.077/15.0	.067/14.0	.057/13.7	.053/13.4
20	7	.019/13.7	.029/13.7	.051/13.7	.074/ 6.7	.093/ 6.7	.108/ 6.7	.115/ 6.5	.115/ 6.4	.108/ 6.4	.094/ 6.4	.075/ 6.3	.053/ 6.3	.042/ 6.3
	9	.033/19.0	.043/19.0	.066/14.3	.091/10.1	.114/ 7.9	.130/ 7.7	.139/ 7.7	.140/ 7.5	.131/ 7.5	.116/ 7.3	.094/ 7.3	.071/ 7.1	.059/ 7.1
	11	.041/19.0	.050/19.0	.070/19.0	.094/14.6	.116/10.8	.132/10.1	.141/ 9.8	.142/ 8.7	.135/ 8.5	.120/ 8.5	.100/ 8.3	.079/ 8.3	.069/ 8.3
	13	.044/19.0	.051/19.0	.069/19.0	.090/19.0	.110/14.6	.125/11.2	.133/10.8	.135/10.5	.128/10.1	.115/ 9.8	.097/ 9.5	.080/ 9.2	.072/ 9.0
	15	.043/23.3	.049/23.3	.065/19.0	.083/19.0	.101/15.0	.114/14.6	.122/12.1	.123/11.6	.118/11.2	.106/10.8	.091/10.5	.077/10.5	.070/10.1
	17	.041/23.3	.046/23.3	.060/19.0	.076/19.0	.091/19.0	.103/15.0	.110/14.6	.111/14.0	.106/12.1	.097/11.6	.084/11.2	.071/11.2	.066/10.8
	19	.038/23.3	.043/23.3	.054/23.3	.068/19.0	.082/19.0	.092/15.7	.099/15.3	.100/15.0	.096/14.3	.087/13.1	.076/12.6	.065/12.1	.060/12.1
	21	.035/23.3	.039/23.3	.049/23.3	.061/19.0	.073/19.0	.083/19.0	.088/16.5	.089/16.1	.085/15.3	.078/14.6	.068/13.7	.059/13.1	.055/12.8

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 36 - SHIP C, GM = 4 FT, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP C, GM = 4 FT (SPHERICAL TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.094/ 8.5	.101/ 8.5	.118/ 8.5	.139/ 8.5	.157/ 8.5	.170/ 8.5	.176/ 8.5	.173/ 8.5	.163/ 8.3	.146/ 8.3	.127/ 8.3	.111/ 8.3	.105/ 8.3
	9	.159/ 8.7	.170/ 8.7	.195/ 8.7	.224/ 9.0	.250/ 9.2	.268/ 9.2	.275/ 9.2	.271/ 9.2	.255/ 9.2	.231/ 9.2	.204/ 9.5	.182/ 9.5	.173/ 9.5
	11	.190/11.2	.199/11.2	.220/10.5	.246/10.1	.269/ 9.5	.286/ 9.5	.293/ 9.5	.288/ 9.5	.274/ 9.8	.253/ 9.8	.229/10.5	.210/10.8	.203/10.8
	13	.194/11.6	.200/11.6	.215/11.6	.235/10.8	.253/10.5	.266/10.1	.271/10.1	.268/10.1	.257/10.5	.241/10.8	.223/11.2	.209/11.6	.204/11.6
	15	.183/12.6	.187/12.6	.198/12.1	.212/11.6	.225/10.8	.235/10.5	.239/10.5	.237/10.5	.229/10.8	.217/11.6	.204/12.1	.195/12.1	.191/12.6
	17	.166/13.1	.169/13.1	.177/12.8	.187/12.1	.197/11.6	.204/10.8	.207/10.5	.206/10.8	.200/11.6	.192/12.1	.182/12.6	.176/12.8	.173/13.1
	19	.149/13.7	.151/13.4	.157/13.4	.164/12.8	.172/12.1	.177/11.2	.180/10.8	.179/11.2	.174/12.1	.168/12.6	.161/13.1	.156/13.4	.154/13.4
	21	.132/14.3	.134/14.3	.138/14.0	.144/13.4	.150/12.6	.154/11.6	.156/11.2	.155/11.6	.152/12.6	.147/13.1	.142/13.7	.138/14.0	.137/14.0
5	7	.089/ 9.5	.099/ 9.2	.120/ 9.0	.143/ 8.7	.163/ 8.3	.175/ 8.3	.180/ 8.3	.175/ 8.3	.162/ 8.3	.143/ 8.3	.121/ 8.1	.102/ 7.9	.095/ 7.5
	9	.128/ 9.5	.142/ 9.5	.173/ 9.5	.209/ 9.5	.241/ 9.2	.265/ 9.2	.278/ 9.2	.278/ 9.2	.267/ 9.0	.247/ 9.2	.222/ 9.2	.202/ 9.2	.194/ 9.2
	11	.146/13.1	.157/12.8	.185/ 9.8	.219/ 9.8	.253/ 9.5	.280/ 9.5	.298/ 9.5	.305/ 9.5	.302/ 9.5	.290/ 9.8	.274/ 9.8	.261/ 9.8	.255/ 9.8
	13	.148/13.7	.156/13.7	.177/13.4	.205/10.5	.234/ 9.8	.259/ 9.8	.278/ 9.8	.288/ 9.8	.290/10.1	.286/10.1	.278/10.1	.271/10.5	.268/10.5
	15	.140/14.6	.146/14.3	.162/14.3	.184/13.4	.207/10.5	.228/10.1	.245/10.1	.257/10.1	.262/10.5	.261/10.5	.258/10.8	.255/10.8	.253/10.8
	17	.128/15.0	.133/15.0	.145/15.0	.162/14.3	.181/13.1	.198/10.5	.213/10.5	.224/10.5	.230/10.5	.232/10.8	.231/10.8	.230/11.2	.229/11.2
	19	.116/15.7	.119/15.7	.129/15.3	.142/15.0	.157/14.0	.172/10.8	.185/10.5	.194/10.5	.200/10.8	.203/11.2	.204/11.2	.204/11.2	.203/11.6
	21	.104/16.5	.107/16.5	.114/16.1	.125/15.7	.137/14.6	.149/10.8	.160/10.8	.169/10.8	.175/10.8	.178/11.2	.179/11.6	.179/11.6	.179/11.6
10	7	.065/10.1	.080/10.1	.111/ 8.5	.140/ 8.5	.164/ 8.5	.178/ 8.5	.183/ 8.3	.178/ 8.3	.163/ 8.1	.140/ 8.1	.115/ 7.9	.094/ 7.9	.086/ 7.9
	9	.093/10.5	.111/10.5	.149/ 9.8	.191/ 8.7	.230/ 8.7	.259/ 8.7	.277/ 8.7	.282/ 8.7	.273/ 8.7	.255/ 8.7	.231/ 8.7	.210/ 8.7	.202/ 8.7
	11	.106/15.7	.120/15.7	.155/10.5	.196/ 9.8	.239/ 9.5	.276/ 9.5	.304/ 9.2	.322/ 9.2	.328/ 9.2	.324/ 9.2	.314/ 9.2	.304/ 9.2	.301/ 9.2
	13	.108/16.5	.119/16.1	.146/16.1	.182/10.5	.220/ 9.8	.257/ 9.5	.289/ 9.5	.312/ 9.5	.327/ 9.5	.334/ 9.5	.335/ 9.8	.333/ 9.8	.332/ 9.8
	15	.104/17.0	.112/17.0	.133/16.5	.162/10.8	.195/10.1	.228/ 9.8	.258/ 9.8	.282/ 9.8	.300/ 9.8	.312/ 9.8	.318/ 9.8	.320/ 9.8	.321/ 9.8
	17	.097/17.5	.103/17.5	.119/17.5	.142/16.5	.170/10.5	.198/ 9.8	.225/ 9.8	.248/ 9.8	.266/ 9.8	.279/ 9.8	.287/10.1	.291/10.1	.292/10.1
	19	.089/18.5	.093/18.0	.106/18.0	.125/17.5	.148/10.5	.172/10.1	.195/ 9.8	.216/ 9.8	.233/10.1	.245/10.1	.253/10.1	.258/10.1	.259/10.1
	21	.080/19.0	.084/19.0	.094/18.5	.110/18.0	.129/17.0	.149/10.1	.169/10.1	.188/10.1	.203/10.1	.214/10.1	.222/10.1	.227/10.5	.228/10.5
15	7	.056/ 8.7	.077/ 8.5	.112/ 8.5	.144/ 8.5	.169/ 8.5	.185/ 8.5	.189/ 8.5	.182/ 8.3	.165/ 8.3	.140/ 8.3	.112/ 7.9	.089/ 7.7	.081/ 7.5
	9	.073/12.1	.095/ 9.2	.137/ 9.2	.183/ 9.2	.224/ 8.7	.257/ 8.7	.277/ 8.5	.284/ 8.5	.277/ 8.5	.258/ 8.5	.233/ 8.5	.211/ 8.5	.203/ 8.5
	11	.080/20.3	.097/12.6	.136/ 9.5	.184/ 9.2	.233/ 9.2	.277/ 9.0	.314/ 9.0	.338/ 9.0	.351/ 9.0	.352/ 9.0	.346/ 9.0	.338/ 9.0	.335/ 9.0
	13	.081/20.3	.094/20.3	.126/12.6	.168/ 9.2	.215/ 9.2	.262/ 9.2	.305/ 9.2	.339/ 9.2	.364/ 9.2	.380/ 9.2	.388/ 9.2	.391/ 9.2	.391/ 9.2
	15	.079/20.3	.088/20.3	.113/20.3	.149/ 9.5	.190/ 9.2	.234/ 9.2	.275/ 9.2	.312/ 9.2	.342/ 9.2	.363/ 9.5	.377/ 9.5	.385/ 9.5	.387/ 9.5
	17	.074/20.9	.081/20.9	.101/20.9	.130/ 9.5	.165/ 9.5	.204/ 9.2	.242/ 9.5	.276/ 9.5	.306/ 9.5	.328/ 9.5	.344/ 9.5	.354/ 9.5	.357/ 9.5
	19	.068/21.7	.074/21.7	.090/20.9	.114/20.3	.144/ 9.5	.177/ 9.5	.210/ 9.5	.241/ 9.5	.268/ 9.5	.290/ 9.5	.306/ 9.5	.315/ 9.5	.318/ 9.5
	21	.062/21.7	.067/21.7	.080/21.7	.100/20.9	.125/ 9.5	.153/ 9.5	.182/ 9.5	.210/ 9.5	.234/ 9.5	.254/ 9.5	.268/ 9.8	.277/ 9.8	.280/ 9.8
20	7	.052/ 9.0	.073/ 9.0	.109/ 9.0	.142/ 9.0	.167/ 9.0	.183/ 9.0	.187/ 9.0	.181/ 9.0	.164/ 9.0	.139/ 7.7	.110/ 7.7	.086/ 7.5	.078/ 5.2
	9	.061/14.0	.083/ 9.5	.128/ 9.2	.175/ 9.0	.218/ 9.0	.253/ 9.0	.274/ 8.7	.282/ 8.5	.276/ 8.3	.257/ 8.3	.231/ 8.3	.207/ 8.3	.197/ 8.3
	11	.063/19.0	.082/19.0	.124/ 9.2	.175/ 9.0	.229/ 9.0	.280/ 9.0	.322/ 8.7	.352/ 8.7	.369/ 8.7	.373/ 8.7	.368/ 8.7	.360/ 8.7	.357/ 8.7
	13	.062/23.3	.077/23.3	.112/ 9.8	.160/ 9.0	.214/ 9.0	.270/ 9.0	.322/ 9.0	.366/ 9.0	.399/ 9.0	.421/ 9.0	.434/ 9.0	.439/ 9.0	.441/ 9.0
	15	.060/23.3	.071/23.3	.100/23.3	.141/ 9.2	.190/ 9.0	.243/ 9.0	.296/ 9.0	.343/ 9.0	.382/ 9.0	.413/ 9.0	.433/ 9.0	.445/ 9.0	.449/ 9.0
	17	.057/26.2	.065/26.2	.088/23.3	.123/ 9.2	.166/ 9.0	.213/ 9.0	.262/ 9.0	.307/ 9.0	.346/ 9.0	.378/ 9.0	.401/ 9.0	.415/ 9.0	.419/ 9.2
	19	.053/26.2	.060/26.2	.078/26.2	.107/ 9.2	.144/ 9.0	.185/ 9.0	.228/ 9.0	.269/ 9.0	.306/ 9.2	.336/ 9.2	.358/ 9.2	.372/ 9.2	.377/ 9.2
	21	.049/27.3	.054/27.3	.070/26.2	.094/23.3	.125/ 9.2	.161/ 9.0	.198/ 9.0	.235/ 9.2	.268/ 9.2	.295/ 9.2	.316/ 9.2	.328/ 9.2	.333/ 9.2

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 37 - SHIP D, ROOT MEAN SQUARE HEAVE RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP D (MEMBRANE TANKS)

RMS HEAVE IN FEET/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.018/ 9.0	.022/ 9.0	.031/ 9.0	.041/ 9.0	.049/ 9.0	.054/ 9.0	.056/ 9.0	.055/ 9.0	.051/ 9.0	.044/ 9.0	.035/ 9.0	.026/ 9.0	.022/ 9.0
	9	.042/ 9.8	.050/ 9.8	.069/ 9.8	.089/ 9.8	.105/ 9.8	.116/ 9.8	.121/ 9.8	.118/ 9.8	.109/ 9.8	.094/ 9.8	.075/ 9.8	.057/ 9.8	.049/ 9.8
	11	.066/13.7	.076/13.4	.098/12.6	.122/11.6	.143/11.2	.157/11.2	.162/11.2	.158/11.2	.146/11.2	.127/11.2	.104/10.8	.082/13.1	.072/13.4
	13	.096/15.3	.104/15.0	.124/14.6	.148/14.3	.168/13.7	.182/13.7	.187/13.4	.183/13.4	.171/13.7	.151/14.0	.129/14.6	.109/15.0	.100/15.0
	15	.126/16.5	.132/16.5	.149/16.5	.169/16.1	.187/15.7	.199/15.7	.204/15.7	.200/15.7	.188/15.7	.171/16.1	.152/16.5	.136/16.5	.129/16.5
	17	.152/18.5	.157/18.5	.169/18.0	.186/18.0	.201/17.5	.211/17.5	.215/17.5	.212/17.5	.202/17.5	.188/18.0	.172/18.0	.159/18.5	.154/18.5
	19	.172/19.6	.176/19.6	.186/19.6	.199/19.6	.211/19.6	.220/19.0	.223/19.0	.220/19.0	.212/19.6	.200/19.6	.188/19.6	.178/19.6	.174/19.6
	21	.188/21.7	.191/21.7	.199/21.7	.209/21.7	.219/21.7	.226/21.7	.229/21.7	.227/21.7	.220/21.7	.211/21.7	.201/21.7	.193/21.7	.190/21.7
5	7	.019/10.5	.024/ 9.2	.033/ 9.0	.042/ 9.0	.050/ 9.0	.054/ 9.0	.056/ 9.0	.054/ 8.7	.049/ 8.7	.041/ 8.7	.032/ 8.7	.022/ 8.5	.017/ 8.5
	9	.039/11.6	.049/10.8	.068/10.5	.089/10.1	.106/ 9.8	.117/ 9.8	.121/ 9.8	.119/ 9.8	.109/ 9.8	.094/ 9.5	.075/ 9.5	.056/ 9.5	.047/ 9.2
	11	.063/15.0	.073/15.0	.096/12.1	.121/11.6	.143/11.6	.158/11.2	.164/11.2	.161/11.2	.149/11.2	.131/11.2	.108/11.2	.086/11.6	.077/12.1
	13	.093/16.5	.101/16.5	.122/16.1	.146/15.3	.167/14.0	.182/13.7	.189/13.4	.186/13.1	.175/13.1	.156/13.1	.135/13.4	.115/13.7	.107/13.7
	15	.123/18.0	.129/18.0	.146/18.0	.166/17.0	.185/16.5	.199/16.1	.205/15.7	.203/15.3	.193/15.0	.177/15.0	.158/15.3	.143/15.3	.136/15.3
	17	.148/19.6	.153/19.6	.167/19.6	.183/19.0	.199/18.5	.211/18.0	.216/17.5	.214/17.0	.206/17.0	.193/17.0	.178/17.0	.165/17.0	.161/17.0
	19	.169/21.7	.173/21.7	.183/20.9	.197/20.9	.210/20.3	.219/19.6	.224/19.0	.222/19.0	.216/19.0	.205/18.5	.193/18.5	.183/18.5	.180/18.5
	21	.185/23.3	.188/23.3	.196/23.3	.207/22.4	.218/22.4	.226/21.7	.230/21.7	.229/20.9	.223/20.9	.214/20.9	.205/20.3	.198/20.3	.195/20.3
10	7	.018/11.6	.023/ 9.2	.033/ 9.2	.042/ 9.0	.050/ 9.0	.055/ 9.0	.056/ 9.0	.054/ 9.0	.048/ 8.7	.040/ 8.7	.029/ 8.5	.019/ 8.5	.013/ 8.5
	9	.036/14.6	.046/11.6	.067/10.1	.088/ 9.8	.105/ 9.8	.117/ 9.8	.122/ 9.8	.119/ 9.8	.109/ 9.5	.094/ 9.5	.074/ 9.5	.054/ 9.5	.045/ 9.5
	11	.060/17.5	.070/14.6	.094/14.0	.120/12.1	.142/11.2	.158/10.8	.166/10.8	.164/10.5	.153/10.5	.135/10.5	.113/10.5	.092/10.5	.083/10.5
	13	.090/18.5	.099/18.5	.120/18.0	.144/15.0	.167/14.3	.183/13.4	.191/13.1	.190/12.6	.180/12.6	.164/12.1	.143/12.1	.125/12.1	.118/12.6
	15	.120/20.3	.127/20.3	.144/19.6	.165/19.0	.185/17.5	.200/16.1	.207/15.3	.207/15.0	.199/14.3	.184/14.3	.167/14.0	.153/14.0	.147/14.0
	17	.146/21.7	.151/21.7	.164/20.9	.181/20.3	.198/19.6	.211/18.5	.218/17.5	.218/17.0	.211/16.5	.199/16.1	.186/16.1	.175/16.1	.170/15.7
	19	.166/23.3	.170/23.3	.181/22.4	.195/22.4	.209/21.7	.220/20.3	.225/19.6	.225/19.0	.220/18.5	.211/18.0	.200/17.5	.191/17.5	.188/17.5
	21	.183/25.1	.186/25.1	.194/24.2	.206/24.2	.217/23.3	.226/22.4	.231/21.7	.231/20.9	.227/20.3	.219/19.6	.211/19.6	.204/19.6	.202/19.0
15	7	.017/14.3	.022/10.5	.033/ 9.5	.043/ 9.2	.051/ 9.2	.055/ 9.0	.056/ 9.0	.054/ 9.0	.048/ 8.7	.039/ 8.7	.028/ 8.5	.017/ 8.5	.011/ 8.3
	9	.034/14.3	.045/10.8	.066/10.5	.087/10.1	.105/ 9.8	.117/ 9.8	.121/ 9.5	.119/ 9.5	.109/ 9.2	.093/ 9.2	.073/ 9.2	.054/ 9.0	.045/ 9.0
	11	.058/20.9	.069/17.5	.093/14.3	.119/11.2	.142/10.8	.159/10.8	.167/10.5	.167/10.1	.157/10.1	.140/ 9.8	.119/ 9.8	.100/ 9.8	.092/ 9.5
	13	.088/21.7	.097/21.7	.118/21.7	.143/15.0	.167/14.3	.184/13.1	.194/12.6	.195/12.1	.188/11.6	.173/11.2	.155/10.8	.139/10.8	.133/10.8
	15	.118/22.4	.125/22.4	.142/22.4	.163/21.7	.184/17.5	.201/16.1	.210/15.3	.212/14.3	.206/13.7	.195/13.1	.180/12.8	.168/12.8	.163/12.6
	17	.144/24.2	.149/24.2	.162/23.3	.180/23.3	.198/21.7	.212/19.0	.221/17.5	.223/16.5	.218/15.7	.209/15.3	.198/15.0	.188/14.6	.184/14.6
	19	.164/25.1	.168/25.1	.179/25.1	.193/24.2	.208/23.3	.220/21.7	.228/19.6	.230/18.5	.226/17.5	.219/17.0	.210/17.0	.202/16.5	.200/16.5
	21	.181/27.3	.184/26.2	.193/26.2	.204/26.2	.216/24.2	.226/22.4	.233/21.7	.234/20.9	.232/19.6	.226/19.0	.219/18.5	.213/18.5	.211/18.5
20	7	.017/19.0	.023/10.1	.035/10.1	.045/ 9.8	.053/ 8.7	.058/ 8.7	.058/ 8.7	.055/ 8.7	.049/ 8.5	.039/ 8.5	.027/ 8.5	.016/ 8.3	.009/ 8.1
	9	.033/19.0	.044/11.2	.066/10.8	.087/10.1	.105/ 9.8	.116/ 9.2	.121/ 9.2	.118/ 9.2	.109/ 9.0	.093/ 9.0	.073/ 9.0	.053/ 8.7	.043/ 8.7
	11	.057/23.3	.068/23.3	.092/23.3	.118/11.6	.142/11.2	.159/10.1	.169/ 9.8	.169/ 9.8	.161/ 9.5	.145/ 9.5	.125/ 9.2	.107/ 9.2	.099/ 9.2
	13	.087/26.2	.095/26.2	.116/26.2	.142/16.5	.167/13.4	.186/12.6	.197/12.1	.200/10.8	.195/10.1	.183/10.1	.167/ 9.8	.154/ 9.8	.148/ 9.8
	15	.117/27.3	.123/27.3	.140/27.3	.162/26.2	.184/17.5	.202/16.5	.214/15.0	.218/13.4	.215/12.8	.206/12.1	.195/11.6	.185/11.2	.181/10.8
	17	.142/27.3	.147/27.3	.161/27.3	.179/27.3	.198/23.3	.213/18.0	.224/17.0	.229/16.1	.227/15.3	.220/14.3	.212/13.7	.204/13.4	.201/13.4
	19	.163/28.6	.167/28.6	.177/27.3	.192/27.3	.208/27.3	.221/21.7	.230/19.6	.235/18.0	.234/17.0	.229/16.5	.222/15.7	.216/15.3	.214/15.3
	21	.179/29.9	.183/29.9	.191/28.6	.203/27.3	.216/27.3	.227/23.3	.235/20.9	.238/20.9	.238/19.0	.234/18.5	.229/17.5	.225/17.5	.223/17.5

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 38 - SHIP D, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP D (MEMBRANE TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.005/ 8.1	.005/ 8.1	.006/ 8.1	.007/ 8.1	.007/ 7.9	.008/ 7.7	.008/ 7.5	.008/ 7.5	.007/ 7.7	.007/ 7.9	.006/ 8.1	.005/ 8.1	.005/ 8.1
	9	.007/ 9.0	.007/ 9.0	.008/ 9.0	.008/ 9.0	.009/ 9.0	.009/ 8.3	.009/ 8.3	.009/ 8.3	.009/ 8.3	.008/ 8.3	.007/ 9.0	.007/ 9.0	.007/ 9.0
	11	.009/14.6	.009/14.6	.010/14.6	.011/14.6	.012/14.6	.012/14.6	.012/14.6	.012/14.6	.012/14.6	.011/14.6	.010/14.6	.009/14.6	.009/14.6
	13	.024/19.0	.025/19.0	.027/19.0	.029/19.0	.032/19.0	.033/19.0	.034/19.0	.033/19.0	.031/19.0	.029/19.0	.026/19.0	.024/19.0	.023/19.0
	15	.053/19.0	.054/19.0	.059/19.0	.064/19.0	.069/19.0	.073/19.0	.074/19.0	.072/19.0	.068/19.0	.063/19.0	.057/19.0	.053/19.0	.051/19.0
	17	.076/19.0	.078/19.0	.085/19.0	.092/19.0	.100/19.0	.104/19.0	.106/19.0	.104/19.0	.098/19.0	.091/19.0	.082/19.0	.076/19.0	.073/19.0
	19	.086/19.0	.089/19.0	.096/19.0	.105/19.0	.114/19.0	.119/19.0	.121/19.0	.118/19.0	.112/19.0	.103/19.0	.094/19.0	.086/19.0	.083/19.0
	21	.087/19.0	.090/19.0	.098/19.0	.107/19.0	.115/19.0	.121/19.0	.123/19.0	.120/19.0	.114/19.0	.105/19.0	.095/19.0	.087/19.0	.084/19.0
5	7	.008/ 9.5	.008/ 9.5	.008/ 9.5	.008/ 9.2	.009/ 9.2	.009/ 7.9	.008/ 7.9	.008/ 7.9	.007/ 7.1	.006/ 7.0	.005/ 7.0	.004/ 7.0	.004/ 7.0
	9	.010/10.8	.010/10.8	.011/10.8	.011/10.5	.011/ 9.5	.011/ 9.5	.010/ 9.5	.009/ 8.1	.008/ 8.1	.007/ 7.9	.006/ 7.9	.005/ 7.7	.005/ 7.7
	11	.015/18.5	.016/18.5	.016/18.5	.016/18.5	.016/18.5	.015/18.5	.014/15.3	.013/15.0	.011/15.0	.009/14.6	.007/14.3	.006/13.4	.006/13.1
	13	.042/19.0	.042/19.0	.043/19.0	.043/19.0	.043/19.0	.041/19.0	.037/19.0	.032/19.0	.027/19.0	.022/19.0	.017/19.0	.014/19.0	.013/19.0
	15	.073/19.0	.074/19.0	.077/19.0	.080/19.0	.081/19.0	.080/19.0	.075/19.0	.067/19.0	.058/19.0	.049/19.0	.040/19.0	.034/19.0	.032/19.0
	17	.091/19.0	.093/19.0	.098/19.0	.104/19.0	.108/19.0	.108/19.0	.104/19.0	.096/19.0	.086/19.0	.075/19.0	.064/19.0	.056/19.0	.053/19.0
	19	.096/19.0	.098/19.0	.105/19.0	.112/19.0	.118/19.0	.120/19.0	.117/19.0	.110/19.0	.100/19.0	.089/19.0	.077/19.0	.069/19.0	.066/19.0
	21	.092/19.0	.095/19.0	.102/19.0	.111/19.0	.117/19.0	.120/19.0	.119/19.0	.113/19.0	.104/19.0	.093/19.0	.082/19.0	.073/19.0	.070/19.0
10	7	.014/12.8	.014/12.8	.014/12.8	.013/12.8	.012/12.8	.011/12.8	.010/11.6	.008/11.6	.007/ 6.8	.005/ 6.8	.004/ 6.7	.003/ 6.3	.003/ 6.3
	9	.019/12.8	.019/12.8	.018/12.8	.017/12.8	.016/12.8	.015/12.8	.013/11.6	.010/11.6	.008/ 9.2	.007/ 8.3	.005/ 7.3	.004/ 6.8	.004/ 6.8
	11	.039/19.0	.039/19.0	.037/19.0	.035/19.0	.032/19.0	.028/19.0	.023/19.0	.017/19.0	.012/18.5	.009/15.0	.006/14.6	.005/11.6	.004/11.6
	13	.082/19.0	.082/19.0	.080/19.0	.077/19.0	.072/19.0	.064/19.0	.054/19.0	.042/19.0	.030/19.0	.020/19.0	.014/19.0	.010/19.0	.008/19.0
	15	.111/19.0	.111/19.0	.112/19.0	.111/19.0	.108/19.0	.101/19.0	.089/19.0	.074/19.0	.058/19.0	.044/19.0	.032/19.0	.024/19.0	.021/19.0
	17	.120/19.0	.121/19.0	.124/19.0	.127/19.0	.127/19.0	.122/19.0	.112/19.0	.098/19.0	.082/19.0	.066/19.0	.053/19.0	.042/19.0	.039/19.0
	19	.116/19.0	.118/19.0	.123/19.0	.128/19.0	.131/19.0	.129/19.0	.122/19.0	.110/19.0	.096/19.0	.080/19.0	.066/19.0	.056/19.0	.051/19.0
	21	.106/19.0	.109/19.0	.115/19.0	.121/19.0	.126/19.0	.126/19.0	.121/19.0	.112/19.0	.099/19.0	.085/19.0	.072/19.0	.062/19.0	.058/19.0
15	7	.103/19.6	.100/19.6	.091/19.6	.078/19.6	.061/19.6	.045/19.6	.028/17.5	.018/17.5	.008/14.3	.005/10.8	.004/ 7.0	.003/ 5.7	.002/ 5.7
	9	.179/19.6	.173/19.6	.157/19.6	.133/19.6	.102/19.6	.071/19.6	.041/17.5	.021/17.5	.010/14.3	.007/10.8	.005/ 7.9	.004/ 7.0	.003/ 6.3
	11	.182/19.6	.177/19.6	.162/19.6	.138/19.6	.109/19.0	.079/19.0	.051/19.0	.036/19.0	.019/19.0	.010/18.5	.006/15.0	.004/ 9.5	.004/10.5
	13	.167/19.0	.163/19.0	.152/19.0	.135/19.0	.113/19.0	.090/19.0	.067/19.0	.062/19.0	.040/19.0	.023/19.0	.013/19.0	.008/18.5	.006/18.5
	15	.149/19.0	.147/19.0	.141/19.0	.130/19.0	.117/19.0	.101/19.0	.082/19.0	.087/19.0	.064/19.0	.043/19.0	.028/19.0	.019/19.0	.015/19.0
	17	.131/19.0	.130/19.0	.128/19.0	.123/19.0	.116/19.0	.105/19.0	.092/19.0	.105/19.0	.083/19.0	.063/19.0	.046/19.0	.034/19.0	.030/19.0
	19	.113/19.0	.114/19.0	.114/19.0	.113/19.0	.110/19.0	.104/19.0	.094/19.0	.113/19.0	.094/19.0	.076/19.0	.059/19.0	.047/19.0	.042/19.0
	21	.098/19.0	.099/19.0	.100/19.0	.102/19.0	.101/19.0	.098/19.0	.092/19.0	.113/19.0	.097/19.0	.081/19.0	.066/19.0	.054/19.0	.050/19.0
20	7	.082/19.0	.082/19.0	.082/19.0	.082/19.0	.079/19.0	.071/19.0	.058/19.0	.078/19.0	.041/19.0	.006/13.4	.004/ 6.7	.003/ 6.5	.002/ 5.2
	9	.107/19.0	.107/19.0	.107/19.0	.107/19.0	.103/19.0	.093/19.0	.076/19.0	.101/19.0	.053/19.0	.008/13.4	.005/ 8.1	.003/ 7.7	.003/ 7.5
	11	.104/19.0	.104/19.0	.104/19.0	.105/19.0	.101/19.0	.091/19.0	.075/19.0	.102/19.0	.056/19.0	.015/19.0	.006/18.5	.004/ 8.7	.003/ 9.0
	13	.094/19.0	.095/19.0	.097/19.0	.099/19.0	.097/19.0	.089/19.0	.074/19.0	.105/19.0	.064/19.0	.029/19.0	.013/19.0	.006/19.0	.005/18.5
	15	.084/19.0	.085/19.0	.089/19.0	.093/19.0	.093/19.0	.087/19.0	.075/19.0	.112/19.0	.077/19.0	.046/19.0	.027/19.0	.015/19.0	.011/19.0
	17	.073/19.0	.075/19.0	.080/19.0	.085/19.0	.087/19.0	.084/19.0	.075/19.0	.118/19.0	.089/19.0	.062/19.0	.042/19.0	.029/19.0	.024/19.0
	19	.063/19.0	.065/19.0	.071/19.0	.077/19.0	.081/19.0	.079/19.0	.073/19.0	.119/19.0	.096/19.0	.073/19.0	.055/19.0	.041/19.0	.036/19.0
	21	.054/19.0	.057/19.0	.063/19.0	.069/19.0	.073/19.0	.073/19.0	.069/19.0	.116/19.0	.098/19.0	.078/19.0	.061/19.0	.049/19.0	.044/19.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 39 - SHIP D, ROOT MEAN SQUARE PITCH RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP D (MEMBRANE TANKS)

RMS PITCH IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.010/ 8.7	.011/ 8.7	.012/ 8.5	.014/ 8.5	.015/ 8.5	.016/ 8.5	.016/ 8.5	.015/ 8.5	.014/ 8.5	.012/ 8.5	.010/ 8.5	.009/ 8.5	.009/ 8.5
	9	.021/11.2	.022/10.8	.024/ 9.2	.026/ 9.2	.027/ 9.2	.029/ 9.8	.029/ 9.8	.028/ 9.8	.026/ 9.8	.024/ 9.8	.022/10.8	.020/10.8	.020/11.2
	11	.031/12.1	.032/12.1	.033/12.1	.034/12.1	.035/11.2	.035/10.8	.035/10.8	.034/10.8	.034/11.6	.032/12.1	.031/12.1	.031/12.1	.031/12.1
	13	.039/13.4	.038/13.4	.038/13.1	.038/12.8	.037/12.8	.037/12.1	.036/12.1	.036/12.1	.037/12.8	.037/12.8	.038/13.1	.038/13.4	.038/13.4
	15	.042/14.3	.041/14.3	.040/14.3	.039/14.0	.037/13.7	.036/13.4	.035/13.1	.036/13.4	.037/13.7	.038/14.0	.040/14.3	.041/14.3	.041/14.3
	17	.042/15.3	.041/15.3	.040/15.3	.038/15.3	.036/15.0	.034/14.3	.033/14.3	.034/14.3	.035/15.0	.037/15.0	.040/15.3	.041/15.3	.042/15.3
	19	.040/16.5	.040/16.5	.038/16.1	.036/16.1	.033/15.7	.031/15.7	.030/15.3	.031/15.7	.033/16.1	.036/16.5	.038/16.5	.040/16.5	.040/16.5
	21	.038/17.5	.038/17.5	.036/17.5	.033/17.0	.031/17.0	.028/16.5	.028/16.5	.028/17.0	.030/17.0	.033/17.5	.036/17.5	.037/17.5	.038/17.5
5	7	.011/ 9.5	.012/ 9.5	.014/ 9.2	.015/ 8.7	.016/ 8.5	.016/ 8.5	.016/ 8.5	.015/ 8.5	.013/ 8.5	.011/ 8.5	.009/ 8.3	.007/ 7.7	.007/ 7.7
	9	.020/10.8	.021/10.8	.023/10.8	.025/ 9.8	.027/ 9.8	.028/ 9.8	.028/ 9.5	.027/ 9.5	.026/ 9.5	.023/ 9.5	.021/ 9.8	.020/ 9.8	.019/ 9.8
	11	.029/14.0	.029/14.0	.031/14.0	.032/13.7	.033/12.8	.034/10.8	.034/10.5	.034/10.5	.034/10.5	.033/10.8	.033/10.8	.032/10.8	.032/10.8
	13	.036/15.3	.036/15.0	.036/15.0	.036/14.6	.035/14.3	.036/13.4	.036/12.1	.037/11.6	.038/11.6	.039/11.6	.040/12.1	.040/12.1	.041/12.1
	15	.039/16.1	.039/16.1	.038/16.1	.037/15.7	.035/15.3	.035/14.6	.035/13.4	.036/12.8	.038/12.6	.040/12.8	.042/12.8	.044/12.8	.044/12.8
	17	.039/17.0	.039/17.0	.038/17.0	.036/17.0	.034/16.5	.033/15.7	.033/14.6	.034/13.7	.037/13.7	.039/13.7	.042/13.7	.044/14.0	.044/14.0
	19	.038/18.0	.038/18.0	.036/18.0	.034/18.0	.032/17.5	.030/16.5	.030/15.7	.032/14.6	.034/14.6	.037/14.6	.040/14.6	.042/15.0	.043/15.0
	21	.036/19.0	.036/19.0	.034/19.0	.032/19.0	.029/18.5	.028/18.0	.027/16.5	.029/16.1	.032/15.7	.035/16.1	.037/16.1	.039/16.1	.040/16.1
10	7	.010/12.8	.011/12.8	.013/10.5	.015/ 8.7	.017/ 8.7	.017/ 8.5	.017/ 8.5	.015/ 8.5	.013/ 8.3	.010/ 8.3	.007/ 8.3	.006/ 8.1	.005/ 8.3
	9	.018/14.0	.019/13.4	.021/12.8	.024/10.8	.026/10.8	.027/ 9.2	.027/ 9.2	.026/ 9.0	.025/ 9.0	.022/ 9.0	.020/ 9.2	.018/ 9.2	.018/ 9.2
	11	.026/16.5	.027/16.5	.028/16.5	.030/16.1	.031/14.0	.033/10.8	.034/10.1	.034/ 9.8	.034/ 9.8	.034/ 9.8	.033/ 9.8	.033/10.1	.033/10.1
	13	.033/17.5	.033/17.5	.033/17.5	.033/17.0	.034/16.5	.035/15.7	.036/11.2	.037/10.8	.039/10.8	.040/10.8	.041/10.8	.042/10.8	.043/10.8
	15	.036/18.5	.036/18.5	.035/18.0	.035/18.0	.034/17.5	.034/17.0	.035/12.8	.037/11.6	.039/11.6	.042/11.6	.044/11.6	.046/11.6	.046/11.6
	17	.037/19.0	.037/19.0	.036/19.0	.034/19.0	.033/18.5	.032/17.5	.033/15.7	.035/12.8	.038/12.6	.041/12.6	.044/12.6	.046/12.6	.047/12.6
	19	.036/20.3	.036/20.3	.034/20.3	.033/19.6	.031/19.6	.030/18.5	.030/16.5	.032/14.0	.035/13.4	.039/13.4	.042/13.4	.044/13.4	.045/13.7
	21	.035/20.9	.034/20.9	.033/20.9	.031/20.9	.028/20.3	.027/19.6	.027/17.5	.029/15.3	.033/14.3	.036/14.3	.039/14.3	.041/14.3	.042/14.3
15	7	.009/17.5	.010/17.5	.013/ 8.7	.015/ 8.7	.017/ 8.7	.017/ 8.7	.017/ 8.7	.015/ 8.7	.013/ 8.7	.010/ 8.7	.007/ 8.1	.004/ 7.9	.004/ 7.9
	9	.016/19.6	.017/19.6	.020/19.6	.023/12.6	.025/12.6	.026/ 9.5	.027/ 8.7	.026/ 8.7	.024/ 8.7	.021/ 8.7	.018/ 8.7	.017/ 8.7	.016/ 8.7
	11	.024/20.3	.025/20.3	.027/20.3	.028/20.3	.030/16.1	.032/ 9.5	.033/ 9.5	.034/ 9.5	.034/ 9.2	.033/ 9.2	.033/ 9.2	.032/ 9.2	.032/ 9.2
	13	.031/20.9	.031/20.9	.031/20.9	.032/20.3	.033/20.3	.034/18.5	.035/ 9.8	.037/ 9.8	.039/ 9.8	.041/ 9.8	.042/ 9.8	.043/10.1	.043/10.1
	15	.034/20.9	.034/20.9	.034/20.9	.033/20.9	.033/20.9	.033/20.3	.035/10.5	.037/10.5	.040/10.5	.043/10.5	.046/10.8	.047/10.8	.048/10.8
	17	.035/21.7	.035/21.7	.034/21.7	.033/21.7	.032/21.7	.031/20.9	.033/18.5	.035/12.1	.039/11.6	.042/11.6	.045/11.6	.048/11.6	.048/11.6
	19	.035/22.4	.034/22.4	.033/22.4	.031/22.4	.030/21.7	.029/21.7	.030/19.6	.033/13.1	.036/12.6	.040/12.6	.043/12.6	.046/12.6	.046/12.6
	21	.033/23.3	.033/23.3	.031/23.3	.029/23.3	.028/22.4	.027/21.7	.027/20.3	.030/14.0	.033/13.4	.037/13.1	.040/13.1	.043/13.1	.043/13.1
20	7	.008/14.0	.009/14.0	.012/ 9.5	.014/ 9.5	.016/ 9.5	.016/ 9.5	.016/ 9.5	.014/ 9.5	.012/ 9.2	.009/ 9.2	.006/ 9.2	.004/ 7.5	.003/ 7.5
	9	.015/19.0	.016/19.0	.019/19.0	.022/19.0	.024/19.0	.025/14.3	.025/ 9.2	.024/ 9.2	.022/ 8.5	.020/ 8.3	.017/ 8.3	.015/ 8.3	.014/ 8.3
	11	.023/23.3	.024/23.3	.025/23.3	.027/23.3	.029/19.0	.031/19.0	.032/ 9.2	.033/ 9.0	.033/ 9.0	.032/ 8.7	.032/ 8.7	.031/ 8.7	.031/ 8.7
	13	.030/23.3	.030/23.3	.030/23.3	.031/23.3	.032/23.3	.033/23.3	.035/ 9.5	.037/ 9.2	.039/ 9.2	.041/ 9.2	.042/ 9.2	.043/ 9.2	.044/ 9.2
	15	.033/26.2	.033/26.2	.032/26.2	.032/26.2	.032/23.3	.033/23.3	.035/10.1	.037/ 9.8	.041/ 9.8	.044/ 9.8	.046/ 9.8	.048/ 9.8	.049/ 9.8
	17	.034/26.2	.034/26.2	.033/26.2	.032/26.2	.031/26.2	.031/23.3	.033/23.3	.036/10.5	.039/10.5	.043/10.5	.046/10.5	.049/10.5	.049/10.5
	19	.034/27.3	.033/27.3	.032/27.3	.030/27.3	.029/26.2	.029/23.3	.030/23.3	.033/11.6	.037/11.6	.041/11.6	.044/11.6	.047/11.6	.048/11.6
	21	.032/27.3	.032/27.3	.031/27.3	.029/27.3	.027/27.3	.026/26.2	.028/23.3	.030/12.6	.034/12.6	.038/12.6	.041/12.6	.044/12.6	.045/12.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 40 - SHIP D, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP D (MEMBRANE TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.012/ 9.0	.012/ 9.0	.013/ 8.1	.015/ 8.1	.016/ 7.9	.017/ 7.9	.018/ 7.9	.017/ 7.9	.017/ 7.9	.016/ 7.9	.015/ 8.1	.014/ 8.1	.014/ 8.7
	9	.019/ 9.2	.019/ 9.2	.020/ 9.2	.022/ 9.2	.023/ 9.2	.024/ 9.2	.025/ 9.2	.025/ 9.2	.024/ 9.2	.023/ 9.0	.022/ 9.0	.021/ 9.0	.021/ 9.0
	11	.026/13.1	.026/13.1	.027/12.8	.028/12.8	.029/12.1	.029/12.1	.030/11.6	.030/12.1	.030/12.1	.029/12.6	.028/12.8	.028/12.8	.028/12.8
	13	.034/14.3	.034/14.3	.033/14.0	.033/14.0	.033/13.7	.033/13.4	.033/13.1	.033/13.1	.034/13.7	.034/14.0	.035/14.0	.035/14.0	.035/14.0
	15	.039/15.3	.039/15.3	.038/15.3	.037/15.3	.035/15.0	.034/14.6	.034/14.3	.034/14.3	.036/14.6	.037/15.0	.039/15.3	.040/15.3	.040/15.3
	17	.042/16.5	.042/16.5	.040/16.5	.038/16.1	.036/16.1	.034/15.7	.033/15.3	.034/15.7	.036/15.7	.038/16.1	.041/16.1	.042/16.1	.043/16.1
	19	.043/17.5	.042/17.5	.040/17.5	.038/17.5	.035/17.0	.033/17.0	.032/16.5	.032/17.0	.035/17.0	.038/17.0	.040/17.5	.042/17.5	.043/17.5
	21	.042/18.5	.041/18.5	.039/18.5	.036/18.5	.033/18.5	.031/18.0	.030/17.5	.031/18.0	.033/18.0	.036/18.5	.039/18.5	.041/18.5	.042/18.5
5	7	.011/10.8	.012/10.8	.013/ 9.2	.014/ 8.1	.016/ 8.1	.017/ 7.9	.017/ 7.9	.017/ 7.7	.017/ 7.7	.016/ 7.1	.015/ 7.1	.014/ 7.1	.013/ 7.1
	9	.018/11.2	.019/10.8	.020/10.8	.021/10.8	.023/10.8	.024/ 9.5	.025/ 9.5	.025/ 9.5	.024/ 9.5	.023/ 7.9	.022/ 7.9	.021/ 7.7	.021/ 7.7
	11	.025/15.0	.026/14.6	.026/14.6	.027/14.3	.028/13.7	.029/11.6	.030/11.6	.030/11.2	.030/11.2	.029/11.2	.029/11.6	.028/11.6	.028/11.6
	13	.033/15.7	.033/15.7	.033/15.7	.033/15.7	.033/15.3	.033/14.3	.033/13.4	.033/12.6	.034/12.6	.035/12.6	.035/12.6	.036/12.8	.036/12.8
	15	.039/17.0	.039/17.0	.038/17.0	.036/16.5	.035/16.1	.034/15.7	.034/14.6	.034/14.0	.036/13.7	.037/13.7	.039/14.0	.040/14.0	.041/14.0
	17	.042/18.0	.042/18.0	.040/18.0	.038/18.0	.036/17.5	.034/17.0	.033/15.7	.034/15.0	.036/15.0	.038/15.0	.041/15.0	.042/15.0	.043/15.0
	19	.043/19.0	.042/19.0	.040/19.0	.038/19.0	.035/18.5	.033/18.0	.032/17.0	.033/16.1	.035/16.1	.038/16.1	.041/16.1	.043/16.1	.043/16.1
	21	.042/20.3	.041/20.3	.039/20.3	.036/19.6	.033/19.6	.031/19.0	.030/18.0	.031/17.5	.033/17.0	.036/17.0	.039/17.0	.041/17.5	.042/17.5
10	7	.011/12.8	.011/12.8	.013/12.8	.014/12.8	.016/ 9.0	.017/ 8.7	.017/ 8.3	.017/ 7.9	.016/ 7.5	.015/ 6.4	.014/ 6.4	.013/ 6.4	.013/ 6.4
	9	.018/14.3	.018/14.3	.020/14.3	.021/14.0	.023/11.6	.024/ 9.2	.025/ 9.2	.025/ 9.0	.024/ 9.0	.023/ 9.0	.022/ 9.2	.021/ 6.7	.021/ 6.7
	11	.025/17.5	.025/14.3	.026/14.3	.027/14.3	.028/14.3	.029/14.0	.030/11.2	.030/10.5	.030/10.5	.030/10.5	.029/10.5	.029/10.5	.029/10.5
	13	.033/18.0	.033/18.0	.033/18.0	.033/18.0	.033/17.5	.033/16.5	.033/13.4	.033/12.1	.034/11.6	.035/11.6	.035/11.6	.036/11.6	.036/11.6
	15	.039/19.0	.039/19.0	.038/19.0	.036/18.5	.035/18.5	.034/17.5	.034/15.7	.034/13.4	.036/12.8	.038/12.8	.039/12.8	.041/12.8	.041/12.8
	17	.042/20.3	.041/20.3	.040/19.6	.038/19.6	.035/19.0	.034/18.5	.033/17.0	.034/14.6	.036/14.0	.039/13.7	.041/13.7	.043/14.0	.043/14.0
	19	.042/20.9	.042/20.9	.040/20.9	.037/20.9	.035/20.3	.032/19.6	.032/18.0	.033/16.1	.035/15.0	.038/15.0	.041/15.0	.043/15.0	.043/15.0
	21	.041/21.7	.041/21.7	.039/21.7	.036/21.7	.033/20.9	.031/20.3	.030/19.0	.031/17.0	.033/16.1	.036/16.1	.039/16.1	.041/16.1	.042/16.1
15	7	.011/14.3	.011/14.3	.012/14.3	.014/14.3	.015/14.3	.016/14.3	.017/14.3	.017/10.1	.016/ 7.0	.015/ 5.7	.014/ 5.7	.013/ 5.7	.013/ 5.7
	9	.018/17.5	.018/17.5	.019/14.3	.021/14.3	.022/14.3	.024/14.3	.024/14.3	.025/ 8.5	.024/ 8.5	.023/ 8.5	.022/ 8.5	.021/ 8.5	.021/ 8.5
	11	.025/20.9	.025/20.9	.026/20.3	.027/17.5	.028/14.3	.029/14.3	.030/14.3	.030/ 9.5	.030/ 9.5	.030/ 9.5	.029/ 9.5	.029/ 9.5	.029/ 9.5
	13	.033/20.9	.033/20.9	.033/20.9	.032/20.9	.032/20.9	.032/17.5	.033/17.5	.034/10.8	.034/10.8	.035/10.8	.036/10.8	.036/10.8	.037/10.8
	15	.039/21.7	.038/21.7	.037/21.7	.036/21.7	.035/21.7	.034/20.9	.034/19.0	.035/12.1	.036/12.1	.038/11.6	.040/11.6	.041/11.6	.042/11.6
	17	.042/22.4	.041/22.4	.040/22.4	.037/22.4	.035/21.7	.034/21.7	.033/20.3	.034/14.3	.036/13.1	.039/13.1	.041/12.8	.043/12.8	.044/12.8
	19	.042/23.3	.042/23.3	.040/23.3	.037/23.3	.034/22.4	.032/21.7	.032/20.9	.033/14.6	.035/14.3	.038/14.0	.041/14.0	.043/14.0	.044/14.0
	21	.041/24.2	.041/24.2	.039/24.2	.036/24.2	.033/23.3	.031/22.4	.030/20.9	.031/17.5	.033/15.3	.037/15.3	.039/15.0	.042/15.0	.042/15.0
20	7	.011/19.0	.011/19.0	.012/13.4	.013/13.4	.015/13.4	.016/13.4	.016/13.4	.016/13.4	.015/ 7.1	.014/ 5.2	.013/ 5.2	.012/ 5.2	.012/ 5.2
	9	.017/19.0	.018/19.0	.019/19.0	.020/19.0	.022/19.0	.023/19.0	.024/19.0	.024/ 7.7	.024/ 7.7	.023/ 7.9	.022/ 7.9	.021/ 7.9	.020/ 7.9
	11	.025/23.3	.025/23.3	.026/23.3	.027/23.3	.028/23.3	.029/19.6	.030/19.0	.030/ 8.7	.030/ 8.7	.030/ 8.7	.029/ 8.7	.029/ 8.7	.029/ 8.7
	13	.033/26.2	.033/26.2	.032/26.2	.032/23.3	.032/23.3	.032/23.3	.033/19.6	.034/10.1	.035/10.1	.035/ 9.8	.036/ 9.8	.037/ 9.8	.037/ 9.8
	15	.038/26.2	.038/26.2	.037/26.2	.036/26.2	.034/26.2	.034/23.3	.034/23.3	.035/11.2	.036/11.2	.038/11.2	.040/11.2	.041/11.2	.042/11.2
	17	.041/27.3	.041/27.3	.039/27.3	.037/27.3	.035/26.2	.033/23.3	.033/23.3	.034/12.6	.036/12.1	.039/12.1	.042/12.1	.043/12.1	.044/12.1
	19	.042/27.3	.041/27.3	.040/27.3	.037/27.3	.034/27.3	.032/26.2	.032/23.3	.033/13.4	.035/13.4	.038/13.4	.041/13.4	.043/13.1	.044/13.1
	21	.041/27.3	.040/27.3	.038/27.3	.036/27.3	.033/27.3	.030/26.2	.030/24.2	.031/16.1	.033/15.0	.037/14.3	.040/14.3	.042/14.3	.043/14.3

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 41 - SHIP D, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP D (MEMBRANE TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.023/ 8.5	.032/ 8.1	.052/ 7.9	.073/ 7.7	.090/ 7.5	.103/ 7.5	.110/ 7.5	.109/ 7.3	.102/ 7.3	.089/ 7.3	.071/ 7.1	.052/ 7.1	.042/ 7.1
	9	.041/10.1	.051/ 9.8	.072/ 9.5	.096/ 9.2	.116/ 9.2	.130/ 9.0	.137/ 9.0	.135/ 9.0	.126/ 9.0	.109/ 9.0	.087/ 9.0	.066/ 9.5	.055/ 9.8
	11	.054/11.6	.063/11.2	.082/10.8	.104/10.8	.123/10.5	.136/10.5	.142/10.5	.139/10.5	.129/10.5	.113/10.5	.092/10.8	.072/11.2	.062/11.2
	13	.059/12.6	.066/12.1	.083/12.1	.102/12.1	.119/11.6	.131/11.6	.135/11.6	.133/11.6	.124/11.6	.108/12.1	.090/12.1	.073/12.1	.065/12.6
	15	.059/13.4	.065/13.4	.079/13.1	.096/12.8	.111/12.8	.121/12.8	.125/12.8	.123/12.8	.114/12.8	.101/12.8	.084/13.1	.070/13.1	.063/13.4
	17	.056/14.3	.061/14.3	.073/14.0	.088/14.0	.101/14.0	.109/13.7	.113/13.7	.111/13.7	.104/13.7	.092/14.0	.078/14.0	.065/14.3	.060/14.3
	19	.052/15.3	.056/15.3	.067/15.3	.079/15.3	.091/15.3	.098/15.3	.101/15.3	.100/15.3	.093/15.3	.083/15.3	.071/15.3	.060/15.3	.055/15.3
	21	.047/16.5	.051/16.5	.060/16.5	.071/16.5	.081/17.0	.088/17.0	.091/17.5	.089/18.0	.083/18.0	.074/18.5	.064/18.5	.054/19.0	.050/19.0
5	7	.022/ 9.5	.031/ 8.5	.051/ 8.1	.072/ 7.7	.091/ 7.3	.104/ 7.1	.111/ 7.1	.111/ 7.1	.105/ 7.0	.091/ 7.0	.074/ 7.0	.054/ 6.8	.044/ 6.7
	9	.040/11.2	.049/10.8	.071/10.1	.095/ 9.8	.116/ 9.5	.131/ 9.0	.138/ 8.7	.138/ 8.7	.129/ 8.7	.112/ 8.7	.091/ 8.7	.069/ 8.7	.058/ 9.0
	11	.052/12.6	.060/12.6	.080/12.1	.102/11.2	.122/10.8	.136/10.5	.143/10.1	.141/10.1	.132/10.1	.116/10.1	.095/10.1	.075/10.1	.066/10.5
	13	.057/13.7	.064/13.4	.080/13.1	.100/12.6	.118/12.1	.130/12.1	.136/11.6	.135/11.6	.126/11.2	.111/11.2	.093/11.2	.076/11.2	.068/11.2
	15	.056/14.6	.062/14.6	.076/14.0	.094/13.7	.109/13.4	.120/13.1	.125/12.8	.124/12.6	.116/12.6	.103/12.1	.087/12.1	.073/12.1	.066/12.6
	17	.053/15.7	.058/15.7	.070/15.3	.085/15.0	.099/14.6	.109/14.0	.113/14.0	.112/13.7	.105/13.4	.094/13.4	.080/13.1	.068/13.1	.062/13.4
	19	.049/16.5	.053/16.5	.064/16.1	.077/16.1	.089/16.1	.097/15.7	.101/15.7	.100/15.3	.095/14.6	.085/14.3	.073/14.3	.062/14.3	.057/14.3
	21	.044/17.5	.048/17.5	.058/17.5	.069/17.5	.080/17.5	.087/17.5	.091/18.0	.090/18.0	.085/18.0	.076/18.5	.065/18.5	.056/18.5	.052/18.5
10	7	.021/ 9.5	.030/ 9.5	.050/ 8.3	.072/ 7.3	.091/ 7.1	.105/ 7.1	.113/ 7.0	.113/ 7.0	.106/ 7.0	.093/ 6.8	.075/ 6.7	.056/ 6.4	.045/ 6.3
	9	.038/12.8	.047/11.6	.069/11.2	.094/ 9.5	.116/ 9.0	.131/ 9.0	.140/ 8.7	.140/ 8.5	.131/ 8.3	.115/ 8.3	.094/ 8.3	.072/ 8.3	.061/ 8.3
	11	.049/14.3	.057/13.7	.077/12.8	.100/11.6	.121/11.2	.136/10.8	.144/ 9.8	.143/ 9.8	.135/ 9.5	.119/ 9.5	.099/ 9.5	.078/ 9.5	.069/ 9.5
	13	.053/15.3	.060/15.3	.077/14.6	.097/13.7	.116/12.8	.129/12.1	.136/11.6	.136/11.2	.128/10.8	.114/10.5	.096/10.5	.079/10.5	.071/10.5
	15	.052/16.5	.058/16.1	.073/15.7	.091/15.0	.107/14.3	.119/13.7	.125/12.8	.125/12.6	.118/12.1	.106/11.6	.090/11.6	.075/11.6	.069/11.6
	17	.049/17.0	.054/17.0	.067/16.5	.083/16.1	.097/15.7	.108/15.0	.113/14.3	.113/13.7	.107/13.1	.096/12.8	.082/12.6	.070/12.6	.064/12.6
	19	.045/17.5	.050/17.5	.061/17.5	.074/17.0	.087/16.5	.096/16.1	.101/15.7	.101/15.3	.096/14.3	.087/14.0	.075/13.7	.064/13.4	.059/13.4
	21	.041/18.0	.045/18.0	.055/18.0	.067/18.0	.078/18.0	.086/18.0	.091/18.0	.091/18.0	.086/16.5	.078/16.1	.067/15.3	.058/14.6	.054/14.3
15	7	.020/10.1	.030/10.1	.050/10.1	.072/ 7.0	.091/ 7.0	.106/ 6.8	.113/ 6.8	.114/ 6.8	.107/ 6.7	.094/ 6.5	.076/ 6.5	.056/ 6.3	.045/ 6.3
	9	.037/15.3	.046/12.6	.068/10.1	.093/10.1	.115/ 9.5	.131/ 8.1	.140/ 8.1	.141/ 7.9	.133/ 7.9	.117/ 7.9	.096/ 7.7	.074/ 7.7	.062/ 7.7
	11	.046/15.7	.054/15.7	.074/13.1	.098/12.8	.119/10.5	.135/10.1	.144/ 9.8	.144/ 9.5	.137/ 9.2	.122/ 9.0	.101/ 8.7	.081/ 8.7	.071/ 8.7
	13	.049/18.0	.056/17.5	.074/15.7	.095/13.4	.114/13.1	.128/12.6	.137/11.2	.137/10.5	.130/10.5	.117/10.1	.099/ 9.8	.081/ 9.8	.073/ 9.8
	15	.048/18.0	.054/18.0	.069/17.5	.088/16.1	.105/15.7	.118/13.4	.125/13.1	.126/12.6	.120/11.6	.108/11.2	.092/11.2	.078/10.8	.071/10.8
	17	.045/18.0	.050/18.0	.064/18.0	.080/17.5	.095/16.5	.106/15.7	.113/14.3	.114/13.4	.108/13.1	.098/12.6	.085/12.1	.072/11.6	.066/11.6
	19	.042/20.9	.046/18.0	.058/18.0	.072/18.0	.085/18.0	.095/17.5	.101/16.1	.102/15.3	.097/14.0	.088/13.4	.077/13.1	.066/12.8	.061/12.6
	21	.038/20.9	.042/20.9	.052/18.0	.065/18.0	.076/18.0	.085/18.0	.090/18.0	.091/18.0	.087/16.1	.079/15.3	.069/14.3	.060/13.7	.056/13.7
20	7	.019/19.0	.029/19.0	.049/13.7	.072/ 6.8	.091/ 6.7	.106/ 6.7	.114/ 6.5	.114/ 6.5	.108/ 6.4	.095/ 6.3	.076/ 6.3	.056/ 6.3	.045/ 5.7
	9	.034/19.0	.043/19.0	.066/14.3	.091/10.5	.114/ 7.9	.131/ 7.7	.141/ 7.5	.142/ 7.5	.134/ 7.5	.119/ 7.3	.098/ 7.3	.075/ 7.1	.064/ 7.1
	11	.042/19.0	.050/19.0	.071/19.0	.095/14.6	.118/10.8	.134/10.5	.144/10.1	.145/ 8.7	.138/ 8.5	.124/ 8.3	.103/ 8.3	.083/ 8.3	.073/ 8.1
	13	.044/23.3	.052/23.3	.070/15.3	.092/15.0	.112/15.0	.127/11.2	.136/11.2	.138/10.5	.132/10.1	.119/ 9.8	.101/ 9.2	.084/ 9.2	.076/ 9.0
	15	.044/23.3	.050/23.3	.066/23.3	.085/15.7	.103/15.3	.117/15.0	.125/12.1	.126/11.6	.121/11.2	.110/10.8	.094/10.5	.080/10.1	.073/10.1
	17	.041/23.3	.047/23.3	.060/23.3	.077/16.1	.093/16.1	.105/15.3	.113/15.0	.114/14.3	.110/12.1	.100/12.1	.086/11.6	.074/11.2	.068/11.2
	19	.038/23.3	.043/23.3	.055/23.3	.069/19.0	.083/17.0	.094/16.5	.101/16.1	.102/15.3	.098/14.3	.090/13.1	.078/12.6	.068/12.1	.063/12.1
	21	.035/23.3	.039/23.3	.050/23.3	.062/23.3	.075/18.0	.084/18.0	.090/18.0	.091/17.0	.088/16.1	.081/14.6	.071/13.7	.061/13.1	.057/12.8

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 42 - SHIP D, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP D (MEMBRANE TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.082/ 8.7	.091/ 8.7	.111/ 8.3	.133/ 8.3	.152/ 8.3	.165/ 8.3	.170/ 8.3	.166/ 8.3	.154/ 8.3	.136/ 8.3	.115/ 8.3	.098/ 8.3	.091/ 8.3
	9	.141/ 9.0	.154/ 9.0	.183/ 9.0	.216/ 9.0	.244/ 9.0	.263/ 9.2	.270/ 9.2	.264/ 9.2	.246/ 9.2	.219/ 9.2	.189/ 9.2	.164/ 9.2	.155/ 9.2
	11	.170/11.6	.181/11.6	.207/10.1	.238/ 9.8	.264/ 9.8	.283/ 9.8	.289/ 9.8	.284/ 9.8	.267/ 9.8	.242/ 9.8	.215/10.1	.193/11.2	.185/11.2
	13	.178/12.6	.186/12.1	.205/12.1	.228/11.2	.249/10.1	.264/10.1	.269/10.1	.265/10.1	.252/10.1	.233/10.8	.212/11.6	.196/12.1	.190/12.1
	15	.171/13.1	.177/12.8	.191/12.8	.208/12.1	.223/11.2	.234/10.5	.239/10.5	.236/10.5	.226/10.8	.212/12.1	.197/12.6	.185/12.8	.181/12.8
	17	.159/13.7	.162/13.7	.172/13.4	.185/12.8	.196/12.1	.204/11.2	.208/10.8	.206/10.8	.198/12.1	.188/12.8	.177/13.1	.169/13.4	.166/13.7
	19	.144/14.3	.147/14.3	.154/14.0	.163/13.7	.172/12.8	.178/12.1	.180/11.6	.179/12.1	.173/12.8	.166/13.4	.158/13.7	.152/14.0	.150/14.0
	21	.129/15.0	.131/14.6	.137/14.6	.144/14.0	.150/13.4	.155/12.6	.157/12.1	.156/12.6	.152/13.1	.146/14.0	.140/14.3	.135/14.6	.134/14.6
5	7	.082/ 9.2	.092/ 9.0	.115/ 8.7	.138/ 8.5	.157/ 8.5	.169/ 8.5	.172/ 8.5	.166/ 8.5	.151/ 8.3	.130/ 8.3	.106/ 8.1	.087/ 7.7	.080/ 7.7
	9	.116/ 9.8	.132/ 9.8	.166/ 9.5	.203/ 9.5	.236/ 9.2	.259/ 9.2	.270/ 9.2	.268/ 9.2	.254/ 9.2	.230/ 9.2	.202/ 9.2	.179/ 9.2	.170/ 9.5
	11	.133/13.4	.147/10.8	.178/ 9.8	.215/ 9.8	.249/ 9.8	.276/ 9.8	.292/ 9.5	.296/ 9.5	.289/ 9.8	.273/ 9.8	.252/10.1	.235/10.1	.229/10.1
	13	.138/14.3	.148/14.0	.172/13.7	.202/10.1	.232/ 9.8	.257/ 9.8	.274/ 9.8	.282/10.1	.281/10.1	.272/10.5	.260/10.5	.250/10.8	.246/10.8
	15	.133/15.0	.141/15.0	.159/14.6	.182/14.0	.206/10.1	.228/10.1	.244/10.1	.253/10.5	.255/10.5	.251/10.8	.245/10.8	.239/11.2	.237/11.2
	17	.124/15.7	.130/15.7	.143/15.3	.161/14.6	.181/13.4	.198/10.5	.212/10.5	.221/10.5	.225/10.8	.225/11.2	.222/11.6	.219/11.6	.217/11.6
	19	.114/16.1	.118/16.1	.128/16.1	.142/15.3	.158/14.6	.172/10.8	.185/10.8	.193/10.8	.197/11.2	.198/11.6	.197/12.1	.196/12.1	.195/12.1
	21	.103/17.0	.106/17.0	.114/16.5	.125/16.1	.138/15.3	.150/13.4	.161/10.8	.168/11.2	.173/11.6	.174/12.1	.174/12.1	.173/12.6	.173/12.6
10	7	.062/10.5	.079/ 8.7	.109/ 8.7	.138/ 8.5	.160/ 8.5	.172/ 8.5	.175/ 8.3	.168/ 8.3	.151/ 8.3	.127/ 8.1	.100/ 8.1	.079/ 7.9	.071/ 7.9
	9	.087/10.8	.107/10.5	.147/ 9.0	.189/ 9.0	.226/ 9.0	.253/ 9.0	.267/ 9.0	.269/ 9.0	.257/ 9.0	.235/ 9.0	.207/ 9.0	.184/ 9.0	.176/ 9.0
	11	.100/16.1	.116/12.8	.153/10.1	.195/ 9.8	.236/ 9.2	.271/ 9.2	.296/ 9.2	.309/ 9.2	.310/ 9.2	.301/ 9.5	.287/ 9.5	.274/ 9.5	.269/ 9.5
	13	.104/16.5	.116/16.5	.145/16.5	.181/10.1	.219/ 9.8	.254/ 9.8	.283/ 9.8	.303/ 9.8	.313/ 9.8	.315/ 9.8	.311/ 9.8	.306/ 9.8	.304/ 9.8
	15	.102/17.5	.110/17.5	.133/17.0	.162/10.5	.195/10.1	.226/10.1	.254/ 9.8	.275/ 9.8	.290/10.1	.297/10.1	.299/10.1	.299/10.1	.299/10.1
	17	.096/18.0	.102/18.0	.119/17.5	.143/17.0	.170/10.1	.198/10.1	.223/10.1	.243/10.1	.258/10.1	.268/10.1	.273/10.5	.275/10.5	.276/10.5
	19	.088/18.5	.093/18.5	.107/18.5	.126/17.5	.148/10.1	.172/10.1	.194/10.1	.213/10.1	.227/10.1	.237/10.5	.243/10.5	.247/10.5	.248/10.5
	21	.081/19.0	.085/19.0	.095/19.0	.111/18.5	.130/17.0	.150/10.1	.169/10.1	.185/10.1	.199/10.5	.208/10.5	.215/10.8	.218/10.8	.219/10.8
15	7	.056/ 8.7	.076/ 8.7	.110/ 8.7	.141/ 8.7	.163/ 8.7	.176/ 8.7	.178/ 8.7	.170/ 8.7	.151/ 8.5	.125/ 8.5	.095/ 7.9	.071/ 7.7	.062/ 7.7
	9	.071/12.6	.094/ 9.5	.136/ 9.5	.180/ 9.2	.219/ 9.0	.248/ 8.7	.264/ 8.7	.267/ 8.7	.256/ 8.7	.234/ 8.7	.206/ 8.7	.182/ 8.7	.173/ 8.7
	11	.078/20.3	.096/ 9.8	.136/ 9.5	.182/ 9.5	.228/ 9.5	.269/ 9.2	.301/ 9.0	.321/ 9.0	.328/ 9.0	.324/ 9.0	.313/ 9.0	.302/ 9.0	.298/ 9.0
	13	.080/20.3	.094/20.3	.126/ 9.8	.167/ 9.8	.213/ 9.5	.256/ 9.5	.295/ 9.5	.325/ 9.5	.345/ 9.5	.355/ 9.5	.358/ 9.5	.358/ 9.5	.358/ 9.5
	15	.078/20.9	.088/20.9	.114/20.9	.149/ 9.8	.189/ 9.8	.230/ 9.5	.268/ 9.5	.301/ 9.5	.326/ 9.5	.344/ 9.5	.354/ 9.5	.360/ 9.5	.361/ 9.5
	17	.074/20.9	.082/20.9	.102/20.9	.131/ 9.8	.165/ 9.8	.201/ 9.8	.237/ 9.5	.269/ 9.5	.294/ 9.8	.314/ 9.8	.327/ 9.8	.334/ 9.8	.337/ 9.8
	19	.069/21.7	.075/21.7	.091/21.7	.115/20.9	.144/ 9.8	.175/ 9.8	.207/ 9.8	.236/ 9.8	.260/ 9.8	.279/ 9.8	.293/ 9.8	.301/ 9.8	.303/ 9.8
	21	.064/22.4	.068/22.4	.081/21.7	.101/20.9	.125/ 9.8	.153/ 9.8	.180/ 9.8	.206/ 9.8	.228/ 9.8	.246/10.1	.259/10.1	.266/10.1	.269/10.1
20	7	.050/ 9.2	.070/ 9.2	.104/ 9.2	.133/ 9.2	.155/ 9.2	.168/ 9.2	.170/ 9.2	.162/ 9.2	.144/ 9.2	.119/ 9.2	.090/ 7.7	.066/ 7.5	.058/ 7.3
	9	.060/ 9.8	.082/ 9.5	.124/ 9.5	.168/ 9.2	.207/ 9.2	.237/ 9.2	.255/ 9.2	.259/ 8.5	.250/ 8.3	.229/ 8.3	.201/ 8.3	.176/ 8.3	.166/ 8.3
	11	.062/19.0	.081/10.1	.122/10.1	.170/ 9.5	.220/ 9.2	.266/ 9.2	303/ 9.0	.328/ 8.7	.339/ 8.7	.339/ 8.7	.330/ 8.7	.320/ 8.7	.316/ 8.7
	13	.062/23.3	.077/23.3	.111/10.1	.157/ 9.5	.208/ 9.2	.260/ 9.2	.306/ 9.2	.345/ 9.0	.373/ 9.0	.390/ 9.0	.398/ 9.0	.401/ 9.0	.402/ 9.0
	15	.060/23.3	.072/23.3	.100/10.5	.139/10.1	.186/ 9.5	.236/ 9.2	.284/ 9.2	.327/ 9.2	.362/ 9.2	.387/ 9.2	.404/ 9.2	.414/ 9.2	.417/ 9.2
	17	.058/26.2	.066/26.2	.089/23.3	.122/10.1	.163/ 9.5	.208/ 9.5	.253/ 9.5	.295/ 9.2	.330/ 9.5	.359/ 9.5	.378/ 9.5	.390/ 9.5	.394/ 9.5
	19	.054/26.2	.061/26.2	.079/26.2	.107/10.1	.142/ 9.5	.182/ 9.5	.222/ 9.5	.260/ 9.5	.294/ 9.5	.321/ 9.5	.341/ 9.5	.353/ 9.5	.358/ 9.5
	21	.050/27.3	.056/27.3	.071/27.3	.094/23.3	.124/ 9.5	.158/ 9.5	.194/ 9.5	.228/ 9.5	.259/ 9.5	.284/ 9.5	.303/ 9.5	.314/ 9.5	.318/ 9.5

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 43 - SHIP E, ROOT MEAN SQUARE HEAVE RESPONSES , UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP E (MEMBRANE TANKS)

RMS HEAVE IN FEET/ENCOUNTERED MODAL PERIOD, T_{0E} , IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.011/ 9.2	.014/ 9.2	.021/ 9.2	.027/ 9.2	.032/ 9.2	.036/ 9.2	.037/ 9.2	.036/ 9.2	.033/ 9.2	.028/ 9.2	.021/ 9.2	.015/ 9.2	.012/ 9.2
	9	.033/10.5	.041/10.5	.058/10.5	.075/10.5	.089/10.5	.098/10.5	.102/10.5	.099/10.5	.090/10.5	.076/10.5	.060/10.5	.043/10.5	.035/10.5
	11	.056/10.8	.066/11.2	.089/11.2	.113/11.2	.133/11.2	.145/11.2	.150/11.2	.146/11.2	.134/11.2	.114/11.2	.091/11.2	.069/10.8	.058/10.8
	13	.083/15.3	.093/15.3	.115/14.6	.139/14.0	.160/13.7	.174/13.4	.179/13.4	.175/13.4	.161/13.7	.140/14.0	.116/14.6	.094/15.3	.085/15.3
	15	.112/17.0	.119/17.0	.138/16.5	.160/16.1	.180/15.7	.193/15.7	.198/15.3	.193/15.7	.181/15.7	.161/16.1	.139/16.5	.121/17.0	.113/17.0
	17	.138/18.5	.144/18.5	.159/18.5	.178/18.0	.194/18.0	.206/17.5	.210/17.5	.206/17.5	.195/18.0	.179/18.0	.160/18.5	.145/18.5	.139/18.5
	19	.160/20.3	.164/20.3	.176/20.3	.191/19.6	.205/19.6	.215/19.6	.219/19.6	.215/19.6	.206/19.6	.192/19.6	.177/20.3	.165/20.3	.161/20.3
	21	.177/21.7	.180/21.7	.190/21.7	.202/21.7	.214/21.7	.222/20.9	.225/20.9	.222/20.9	.214/21.7	.203/21.7	.191/21.7	.181/21.7	.178/21.7
5	7	.014/10.5	.017/ 9.8	.023/ 9.5	.029/ 9.5	.033/ 9.5	.036/ 9.5	.037/ 9.2	.035/ 9.2	.032/ 9.2	.026/ 9.2	.019/ 9.2	.012/ 9.0	.009/ 9.0
	9	.033/11.2	.041/10.8	.058/10.8	.076/10.5	.090/10.5	.099/10.5	.102/10.5	.098/10.1	.089/10.1	.075/10.1	.058/10.1	.041/10.1	.032/ 9.8
	11	.053/12.6	.064/12.6	.087/12.1	.112/11.6	.132/11.2	.145/11.2	.150/11.2	.147/11.2	.135/11.2	.116/11.2	.092/11.2	.070/12.1	.060/12.6
	13	.080/17.0	.089/17.0	.112/16.1	.137/14.3	.159/13.4	.174/13.4	.180/13.1	.176/13.1	.164/13.1	.144/13.4	.120/13.7	.098/14.0	.089/14.0
	15	.108/18.5	.116/18.5	.135/18.0	.158/17.5	.178/16.5	.192/15.7	.198/15.3	.195/15.3	.184/15.0	.165/15.3	.144/15.3	.126/15.3	.118/15.7
	17	.134/20.3	.140/20.3	.156/19.6	.175/19.0	.193/18.5	.205/18.0	.211/17.5	.208/17.5	.198/17.0	.183/17.0	.165/17.0	.150/17.5	.145/17.5
	19	.156/21.7	.161/21.7	.173/21.7	.188/20.9	.203/20.3	.214/19.6	.219/19.6	.217/19.0	.209/19.0	.196/19.0	.182/19.0	.170/19.0	.166/19.0
	21	.173/23.3	.177/23.3	.187/23.3	.199/22.4	.212/22.4	.221/21.7	.225/20.9	.224/20.9	.217/20.9	.206/20.9	.195/20.9	.186/20.9	.182/20.9
10	7	.014/12.1	.017/ 9.5	.023/ 9.5	.030/ 9.5	.034/ 9.5	.037/ 9.5	.037/ 9.5	.035/ 9.2	.031/ 9.2	.025/ 9.2	.018/ 9.2	.011/ 9.0	.007/ 8.7
	9	.031/14.0	.040/12.1	.057/10.5	.075/10.5	.089/10.5	.098/10.5	.101/10.5	.098/10.5	.089/10.1	.074/10.1	.057/10.1	.039/ 9.8	.030/ 9.8
	11	.050/15.3	.062/15.0	.085/12.1	.110/11.6	.131/11.2	.145/11.2	.151/11.2	.148/10.8	.136/10.8	.118/10.8	.095/10.8	.073/10.8	.062/11.2
	13	.077/19.0	.086/19.0	.109/15.7	.135/15.0	.158/13.7	.174/13.1	.181/12.8	.179/12.6	.167/12.6	.149/12.6	.126/12.6	.105/12.8	.096/12.8
	15	.105/20.3	.113/20.3	.132/19.6	.156/19.0	.177/17.0	.192/15.7	.200/15.3	.198/14.6	.188/14.3	.171/14.3	.151/14.3	.134/14.3	.127/14.3
	17	.131/21.7	.137/21.7	.153/21.7	.172/20.9	.191/19.6	.205/18.5	.212/17.5	.211/17.0	.203/16.5	.188/16.1	.172/16.1	.158/16.1	.153/16.1
	19	.153/23.3	.158/23.3	.170/23.3	.186/22.4	.202/21.7	.214/20.3	.220/19.6	.220/19.0	.213/18.5	.201/18.0	.188/18.0	.177/18.0	.173/18.0
	21	.171/25.1	.174/25.1	.184/25.1	.197/24.2	.210/23.3	.221/22.4	.226/21.7	.226/20.9	.220/20.3	.211/19.6	.200/19.6	.192/19.6	.189/19.6
15	7	.013/10.8	.017/10.8	.024/10.1	.030/10.1	.035/10.1	.038/10.1	.038/ 9.5	.036/ 9.5	.031/ 9.5	.025/ 9.2	.018/ 9.0	.010/ 9.0	.006/ 8.7
	9	.029/17.5	.038/11.2	.057/10.8	.075/10.8	.089/10.5	.098/10.5	.101/10.1	.098/10.1	.088/10.1	.074/ 9.8	.056/ 9.8	.038/ 9.8	.028/ 9.5
	11	.048/17.5	.060/17.5	.084/11.6	.109/11.2	.130/11.2	.145/11.2	.152/10.8	.149/10.8	.138/10.5	.121/10.5	.098/10.5	.077/10.5	.068/10.5
	13	.074/22.4	.084/21.7	.107/17.5	.134/14.6	.157/13.7	.174/12.6	.183/12.1	.182/12.1	.172/11.6	.155/11.6	.134/11.2	.115/11.2	.107/11.2
	15	.103/23.3	.111/23.3	.130/22.4	.154/21.7	.176/17.5	.193/15.3	.202/14.6	.202/14.3	.194/13.7	.180/13.4	.162/13.4	.146/13.1	.140/13.1
	17	.129/24.2	.135/24.2	.151/24.2	.171/23.3	.190/20.3	.205/18.5	.214/17.5	.215/16.5	.209/15.7	.197/15.3	.182/15.0	.170/15.0	.165/15.0
	19	.151/26.2	.155/25.1	.168/25.1	.184/24.2	.201/23.3	.214/20.9	.222/19.6	.223/18.5	.218/18.0	.209/17.5	.197/17.0	.187/16.5	.184/16.5
	21	.168/27.3	.172/27.3	.182/26.2	.196/26.2	.209/25.1	.221/23.3	.228/21.7	.229/20.3	.225/19.6	.217/19.0	.208/19.0	.201/18.5	.198/18.5
20	7	.013/13.4	.017/13.4	.025/10.5	.032/10.5	.037/10.5	.040/10.5	.040/ 9.2	.038/ 9.2	.033/ 9.2	.026/ 9.0	.018/ 9.0	.010/ 9.0	.005/ 8.5
	9	.028/23.3	.038/11.6	.057/11.2	.075/10.8	.089/10.5	.098/10.5	.101/ 9.8	.097/ 9.8	.088/ 9.8	.073/ 9.8	.055/ 9.5	.036/ 9.5	.027/ 9.5
	11	.047/23.3	.058/23.3	.083/12.1	.108/11.6	.130/11.2	.145/10.8	.152/10.5	.150/10.5	.140/10.1	.123/10.1	.101/10.1	.081/ 9.8	.072/ 9.8
	13	.073/26.2	.083/26.2	.106/26.2	.132/13.4	.157/13.4	.175/12.6	.185/11.6	.186/11.2	.178/10.8	.163/10.8	.144/10.5	.127/10.5	.119/10.5
	15	.101/27.3	.109/27.3	.128/27.3	.152/27.3	.176/17.0	.194/15.7	.205/14.0	.207/13.4	.202/12.8	.190/12.1	.174/11.6	.161/11.2	.156/11.2
	17	.127/27.3	.133/27.3	.149/27.3	.169/27.3	.190/20.9	.206/18.0	.217/17.0	.220/15.7	.216/15.0	.207/14.3	.195/14.0	.185/13.7	.181/13.7
	19	.149/28.6	.153/28.6	.166/28.6	.183/27.3	.200/27.3	.215/20.9	.225/19.6	.228/18.0	.225/17.5	.218/16.5	.209/15.7	.201/15.7	.198/15.3
	21	.166/29.9	.170/29.9	.180/28.6	.194/28.6	.209/27.3	.221/24.2	.230/21.7	.233/20.3	.231/19.0	.226/18.5	.218/18.0	.212/17.5	.210/17.5

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 44 - SHIP E, ROOT MEAN SQUARE ROLL RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP E (MEMBRANE TANKS)

RMS ROLL IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES 0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.002/ 7.5	.002/ 7.5	.003/ 7.5	.004/ 7.5	.004/ 7.5	.005/ 7.7	.005/ 7.7	.005/ 7.7	.004/ 7.7	.004/ 7.5	.003/ 7.5	.002/ 7.5	.002/ 7.5
	9	.002/ 9.8	.003/ 9.8	.004/ 9.5	.005/ 9.5	.006/ 9.2	.006/ 9.2	.007/ 9.0	.006/ 9.0	.006/ 9.2	.005/ 9.2	.004/ 9.5	.003/ 9.5	.002/ 9.5
	11	.003/10.5	.003/10.5	.004/10.5	.005/10.1	.006/10.1	.007/ 9.8	.007/ 9.8	.007/ 9.8	.006/ 9.8	.005/ 9.8	.004/ 9.8	.003/ 9.8	.003/ 9.8
	13	.010/19.0	.010/19.0	.012/19.0	.013/19.0	.014/19.0	.015/19.0	.015/19.0	.015/19.0	.014/19.0	.013/19.0	.011/19.0	.010/19.0	.010/19.0
	15	.024/19.0	.025/19.0	.028/19.0	.031/19.0	.034/19.0	.036/19.0	.036/19.0	.035/19.0	.033/19.0	.030/19.0	.027/19.0	.024/19.0	.023/19.0
	17	.036/19.0	.037/19.0	.041/19.0	.046/19.0	.050/19.0	.052/19.0	.053/19.0	.052/19.0	.049/19.0	.044/19.0	.040/19.0	.036/19.0	.035/19.0
	19	.042/19.6	.043/19.6	.048/19.0	.053/19.0	.058/19.0	.061/19.0	.061/19.0	.060/19.0	.056/19.0	.051/19.0	.046/19.0	.042/19.6	.040/19.6
	21	.042/19.6	.044/19.6	.049/19.6	.054/19.6	.059/19.6	.062/19.6	.063/19.6	.061/19.6	.057/19.6	.052/19.6	.047/19.6	.042/19.6	.041/19.6
5	7	.003/ 9.2	.003/ 9.2	.003/ 9.0	.004/ 8.3	.005/ 7.9	.005/ 7.7	.005/ 7.7	.005/ 7.5	.004/ 7.5	.004/ 7.5	.003/ 7.5	.002/ 7.5	.001/ 7.7
	9	.003/11.2	.004/11.2	.004/ 9.2	.005/ 9.2	.006/ 9.2	.006/ 9.2	.007/ 9.2	.006/ 9.0	.006/ 9.0	.005/ 9.0	.004/ 8.7	.003/ 8.7	.002/ 8.5
	11	.006/19.0	.006/19.0	.006/19.0	.007/19.0	.007/19.0	.008/19.0	.007/19.0	.007/10.1	.006/10.1	.005/ 9.8	.004/ 9.8	.003/ 9.8	.002/ 9.2
	13	.020/19.0	.020/19.0	.021/19.0	.021/19.0	.021/19.0	.020/19.0	.018/19.0	.016/19.0	.013/19.0	.010/19.0	.008/19.0	.006/19.0	.005/19.0
	15	.038/19.0	.039/19.0	.040/19.0	.042/19.0	.043/19.0	.042/19.0	.040/19.0	.036/19.0	.031/19.0	.026/19.0	.021/19.0	.018/19.0	.016/19.0
	17	.048/19.0	.050/19.0	.053/19.0	.056/19.0	.058/19.0	.059/19.0	.057/19.0	.052/19.0	.047/19.0	.040/19.0	.034/19.0	.030/19.0	.028/19.0
	19	.051/19.0	.053/19.0	.057/19.0	.061/19.0	.065/19.0	.066/19.0	.065/19.0	.061/19.0	.055/19.0	.049/19.0	.042/19.0	.037/19.0	.035/19.0
	21	.050/19.0	.052/19.0	.056/19.0	.061/19.0	.065/19.0	.066/19.0	.066/19.0	.063/19.0	.058/19.0	.051/19.0	.045/19.0	.040/19.0	.038/19.0
10	7	.006/11.6	.006/11.6	.006/11.6	.006/11.6	.006/11.6	.006/11.6	.005/11.6	.005/ 7.5	.004/ 7.5	.004/ 7.5	.003/ 7.5	.002/ 7.5	.001/ 7.1
	9	.007/12.8	.007/12.8	.007/11.6	.007/11.6	.007/11.6	.007/11.6	.007/ 9.0	.006/ 9.0	.006/ 8.7	.005/ 8.7	.004/ 8.7	.002/ 8.7	.002/ 8.5
	11	.017/19.0	.017/19.0	.016/19.0	.015/19.0	.014/19.0	.013/19.0	.011/19.0	.009/19.0	.007/19.0	.005/ 9.8	.004/ 9.8	.003/ 9.8	.002/ 9.8
	13	.040/19.0	.040/19.0	.039/19.0	.038/19.0	.036/19.0	.032/19.0	.027/19.0	.021/19.0	.015/19.0	.010/19.0	.006/19.0	.004/19.0	.003/19.0
	15	.056/19.0	.057/19.0	.057/19.0	.058/19.0	.057/19.0	.053/19.0	.047/19.0	.039/19.0	.030/19.0	.023/19.0	.016/19.0	.012/19.0	.010/19.0
	17	.062/19.0	.063/19.0	.065/19.0	.068/19.0	.068/19.0	.066/19.0	.061/19.0	.053/19.0	.044/19.0	.035/19.0	.028/19.0	.022/19.0	.020/19.0
	19	.061/19.0	.062/19.0	.065/19.0	.069/19.0	.071/19.0	.071/19.0	.067/19.0	.060/19.0	.052/19.0	.043/19.0	.035/19.0	.029/19.0	.027/19.0
	21	.056/19.0	.058/19.0	.062/19.0	.066/19.0	.069/19.0	.069/19.0	.067/19.0	.061/19.0	.054/19.0	.046/19.0	.039/19.0	.033/19.0	.031/19.0
15	7	.038/20.3	.037/20.3	.034/20.3	.029/20.3	.023/20.3	.018/20.3	.012/20.3	.008/18.0	.004/ 7.5	.004/ 7.5	.003/ 7.3	.002/ 7.3	.001/ 7.1
	9	.072/19.6	.070/19.6	.064/17.5	.054/17.5	.042/17.5	.029/17.5	.017/17.5	.010/17.5	.006/ 8.5	.005/ 8.5	.004/ 8.5	.002/ 8.5	.002/ 8.5
	11	.081/19.6	.079/19.6	.072/19.0	.062/19.0	.049/19.0	.036/19.0	.024/19.0	.018/19.0	.010/19.0	.006/19.0	.004/ 9.5	.003/ 9.5	.002/ 9.5
	13	.079/19.0	.078/19.0	.073/19.0	.065/19.0	.056/19.0	.045/19.0	.034/19.0	.032/19.0	.021/19.0	.012/19.0	.007/19.0	.004/19.0	.003/19.0
	15	.074/19.0	.073/19.0	.070/19.0	.066/19.0	.061/19.0	.053/19.0	.044/19.0	.047/19.0	.034/19.0	.023/19.0	.015/19.0	.009/19.0	.007/19.0
	17	.066/19.0	.066/19.0	.066/19.0	.064/19.0	.062/19.0	.057/19.0	.050/19.0	.058/19.0	.046/19.0	.034/19.0	.024/19.0	.018/19.0	.015/19.0
	19	.058/19.0	.058/19.0	.059/19.0	.060/19.0	.059/19.0	.057/19.0	.052/19.0	.062/19.0	.052/19.0	.041/19.0	.032/19.0	.025/19.0	.022/19.0
	21	.050/19.0	.051/19.0	.053/19.0	.055/19.0	.055/19.0	.054/19.0	.051/19.0	.062/19.0	.053/19.0	.044/19.0	.035/19.0	.029/19.0	.026/19.0
20	7	.018/19.0	.018/19.0	.018/19.0	.018/19.0	.018/19.0	.016/19.0	.013/19.0	.018/19.0	.010/19.0	.004/13.4	.003/ 7.3	.002/ 7.0	.001/ 6.8
	9	.033/19.0	.033/19.0	.033/19.0	.033/19.0	.032/19.0	.029/19.0	.023/19.0	.032/19.0	.017/19.0	.005/ 8.5	.004/ 8.3	.002/ 8.3	.002/ 8.1
	11	.040/19.0	.040/19.0	.041/19.0	.041/19.0	.040/19.0	.036/19.0	.030/19.0	.040/19.0	.023/19.0	.008/19.0	.004/ 9.2	.003/ 9.2	.002/ 9.0
	13	.041/19.0	.041/19.0	.042/19.0	.043/19.0	.043/19.0	.039/19.0	.033/19.0	.048/19.0	.030/19.0	.015/19.0	.007/19.0	.003/19.0	.002/19.0
	15	.038/19.0	.039/19.0	.041/19.0	.043/19.0	.044/19.0	.041/19.0	.036/19.0	.055/19.0	.039/19.0	.024/19.0	.013/19.0	.007/19.0	.005/19.0
	17	.034/19.0	.036/19.0	.039/19.0	.042/19.0	.043/19.0	.041/19.0	.038/19.0	.060/19.0	.046/19.0	.032/19.0	.021/19.0	.014/19.0	.011/19.0
	19	.030/19.0	.032/19.0	.035/19.0	.039/19.0	.040/19.0	.040/19.0	.037/19.0	.061/19.0	.050/19.0	.038/19.0	.028/19.0	.021/19.0	.018/19.0
	21	.026/19.0	.028/19.0	.031/19.0	.035/19.0	.037/19.0	.037/19.0	.035/19.0	.060/19.0	.051/19.0	.040/19.0	.031/19.0	.025/19.0	.022/19.0

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 45 - SHIP E, ROOT MEAN SQUARE PITCH RESPONSES, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP E (MEMBRANE TANKS)

RMS PITCH IN DEGREES/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.006/ 9.2	.006/ 9.2	.007/ 9.2	.008/ 9.0	.009/ 9.0	.009/ 9.0	.009/ 9.0	.009/ 9.0	.009/ 9.0	.008/ 9.0	.007/ 9.2	.006/ 9.2	.006/ 9.2
	9	.014/ 9.8	.015/ 9.8	.017/ 9.8	.018/ 9.8	.020/ 9.8	.021/ 9.8	.022/ 9.8	.021/ 9.8	.020/ 9.8	.018/ 9.8	.017/ 9.8	.015/ 9.8	.014/ 9.8
	11	.024/12.8	.024/12.8	.025/12.6	.026/12.1	.028/11.2	.029/11.2	.029/11.2	.029/11.2	.028/11.6	.026/12.1	.025/12.6	.024/12.8	.024/12.8
	13	.031/13.7	.031/13.7	.031/13.7	.031/13.4	.031/12.8	.031/12.6	.031/12.6	.031/12.6	.031/12.8	.031/13.4	.031/13.7	.031/13.7	.031/13.7
	15	.035/15.0	.034/14.6	.034/14.6	.033/14.6	.032/14.3	.031/13.7	.031/13.7	.031/13.7	.032/14.0	.033/14.3	.034/14.6	.035/14.6	.035/14.6
	17	.036/15.7	.035/15.7	.034/15.7	.033/15.7	.031/15.3	.030/15.0	.030/14.6	.030/14.6	.031/15.3	.033/15.3	.035/15.7	.036/15.7	.036/15.7
	19	.035/17.0	.035/17.0	.034/16.5	.032/16.5	.030/16.1	.028/15.7	.028/15.7	.028/15.7	.030/16.1	.032/16.5	.034/16.5	.035/17.0	.036/17.0
	21	.034/18.0	.033/18.0	.032/18.0	.030/17.5	.028/17.5	.026/17.0	.025/16.5	.026/17.0	.028/17.5	.030/18.0	.032/18.0	.034/18.0	.034/18.0
5	7	.008/ 9.5	.008/ 9.5	.009/ 9.5	.010/ 9.2	.010/ 9.2	.010/ 9.0	.010/ 9.0	.009/ 9.0	.008/ 9.0	.007/ 9.0	.005/ 8.7	.004/ 8.3	.004/ 8.3
	9	.015/11.6	.015/11.6	.017/10.5	.019/10.5	.020/10.1	.021/10.1	.021/10.1	.021/10.1	.019/ 9.8	.017/ 9.8	.015/10.1	.014/10.5	.013/10.5
	11	.022/14.6	.022/14.3	.024/14.3	.025/13.7	.027/11.6	.028/10.8	.029/10.8	.028/10.8	.028/10.8	.027/11.2	.026/11.2	.025/11.2	.024/11.2
	13	.028/15.7	.029/15.3	.029/15.3	.029/15.0	.030/14.6	.031/13.1	.031/12.1	.032/11.6	.032/11.6	.033/12.1	.033/12.1	.033/12.6	.033/12.6
	15	.032/16.5	.032/16.5	.032/16.5	.031/16.1	.031/15.7	.031/15.0	.031/13.7	.032/13.1	.033/13.1	.035/13.1	.036/13.4	.037/13.4	.037/13.4
	17	.034/17.5	.033/17.5	.032/17.5	.031/17.5	.030/17.0	.029/16.1	.030/14.6	.031/14.0	.033/14.0	.035/14.0	.037/14.3	.038/14.3	.039/14.3
	19	.033/18.5	.033/18.5	.032/18.5	.030/18.5	.028/18.0	.027/17.0	.028/15.7	.029/15.0	.031/15.0	.034/15.0	.036/15.0	.037/15.3	.038/15.3
	21	.032/19.6	.032/19.6	.030/19.6	.029/19.0	.027/19.0	.025/18.0	.025/17.0	.027/16.1	.029/15.7	.032/16.1	.034/16.1	.036/16.1	.036/16.1
10	7	.007/12.8	.008/12.8	.009/12.8	.010/ 9.5	.011/ 9.5	.011/ 9.5	.011/ 9.0	.010/ 9.0	.008/ 9.0	.006/ 8.7	.004/ 8.7	.003/ 8.5	.003/ 8.7
	9	.013/13.4	.014/13.4	.016/12.8	.018/11.6	.020/10.5	.021/ 9.8	.021/ 9.8	.020/ 9.5	.018/ 9.5	.016/ 9.5	.014/ 9.5	.012/ 9.8	.011/ 9.8
	11	.020/17.0	.021/17.0	.022/16.5	.024/14.3	.026/13.4	.027/10.5	.028/10.1	.028/10.1	.028/10.1	.027/10.5	.026/10.5	.025/10.5	.024/10.5
	13	.026/18.0	.026/18.0	.027/18.0	.028/17.5	.029/17.0	.030/11.6	.031/10.8	.032/10.8	.033/10.8	.034/11.2	.034/11.2	.034/11.2	.034/11.2
	15	.030/19.0	.030/18.5	.030/18.5	.029/18.5	.029/18.0	.030/17.0	.031/12.1	.033/11.6	.035/11.6	.036/12.1	.038/12.1	.039/12.1	.039/12.1
	17	.032/19.6	.031/19.6	.031/19.6	.030/19.6	.029/19.0	.029/18.0	.030/14.3	.032/13.1	.034/12.8	.037/12.8	.039/13.1	.040/13.1	.041/13.1
	19	.032/20.3	.031/20.3	.030/20.3	.029/20.3	.027/19.6	.027/19.0	.028/16.5	.030/14.3	.032/13.7	.035/13.7	.038/13.7	.039/14.0	.040/14.0
	21	.031/21.7	.030/21.7	.029/21.7	.027/20.9	.026/20.9	.025/19.6	.025/18.0	.027/15.3	.030/14.6	.033/14.6	.036/14.6	.037/14.6	.038/14.6
15	7	.006/14.3	.007/10.1	.009/ 9.2	.011/ 9.2	.012/ 9.2	.012/ 9.2	.012/ 9.2	.010/ 9.2	.009/ 9.0	.006/ 9.0	.004/ 9.0	.002/ 8.3	.002/ 8.3
	9	.011/20.3	.013/13.1	.015/13.1	.017/13.1	.019/10.1	.020/ 9.5	.020/ 9.5	.019/ 9.5	.018/ 9.5	.015/ 9.2	.013/ 9.2	.011/ 9.2	.010/ 9.2
	11	.018/20.3	.019/20.3	.021/20.3	.023/20.3	.025/14.3	.027/10.1	.028/10.1	.028/ 9.8	.027/ 9.8	.026/ 9.8	.025/ 9.8	.024/ 9.8	.024/ 9.8
	13	.024/20.9	.025/20.9	.025/20.9	.026/20.9	.028/20.9	.029/10.1	.031/10.1	.032/10.1	.034/10.1	.034/10.5	.035/10.5	.035/10.5	.035/10.5
	15	.028/21.7	.028/21.7	.028/21.7	.028/21.7	.028/20.9	.030/20.3	.031/10.8	.033/10.8	.036/10.8	.038/10.8	.040/10.8	.041/11.2	.041/11.2
	17	.030/22.4	.030/22.4	.029/22.4	.028/22.4	.028/21.7	.028/20.9	.030/11.2	.032/11.2	.035/11.6	.038/11.6	.041/11.6	.042/11.6	.043/11.6
	19	.030/23.3	.030/23.3	.029/23.3	.028/22.4	.027/22.4	.027/21.7	.028/19.6	.030/12.8	.034/12.8	.037/12.6	.039/12.8	.041/12.8	.042/12.8
	21	.029/24.2	.029/24.2	.028/24.2	.026/23.3	.025/23.3	.025/22.4	.026/20.3	.028/14.0	.031/13.7	.034/13.4	.037/13.4	.039/13.7	.040/13.7
20	7	.006/14.0	.007/ 9.8	.009/ 9.8	.011/ 9.8	.012/ 9.8	.012/ 9.8	.012/ 9.8	.011/ 9.8	.009/ 9.8	.006/ 9.8	.004/ 9.8	.002/ 7.9	.002/ 7.9
	9	.011/19.0	.012/19.0	.014/19.0	.017/14.6	.019/14.6	.020/ 9.8	.020/ 9.8	.019/ 9.5	.017/ 9.5	.014/ 9.2	.011/ 9.0	.009/ 9.0	.009/ 9.0
	11	.017/23.3	.018/23.3	.020/23.3	.022/23.3	.024/19.0	.026/ 9.8	.027/ 9.8	.027/ 9.5	.027/ 9.5	.026/ 9.5	.024/ 9.5	.023/ 9.5	.023/ 9.5
	13	.023/23.3	.024/23.3	.024/23.3	.025/23.3	.027/23.3	.029/23.3	.031/ 9.8	.032/ 9.8	.034/ 9.8	.035/ 9.8	.035/ 9.8	.035/ 9.8	.035/ 9.8
	15	.027/26.2	.027/26.2	.027/26.2	.027/26.2	.028/23.3	.029/23.3	.031/10.1	.034/10.1	.036/10.1	.039/10.1	.041/10.1	.042/10.1	.042/10.1
	17	.029/27.3	.029/27.3	.028/27.3	.027/26.2	.027/26.2	.028/23.3	.030/10.5	.033/10.5	.036/10.5	.039/10.5	.042/10.8	.044/10.8	.044/10.8
	19	.029/27.3	.029/27.3	.028/27.3	.027/27.3	.026/27.3	.026/26.2	.028/23.3	.031/10.8	.035/11.2	.038/11.2	.041/11.2	.043/11.2	.044/11.6
	21	.028/27.3	.028/27.3	.027/27.3	.026/27.3	.025/27.3	.025/26.2	.026/23.3	.029/11.6	.032/11.6	.036/12.1	.039/12.6	.041/12.6	.041/12.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 46 - SHIP E, ROOT MEAN SQUARE LONGITUDINAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP E (MEMBRANE TANKS)

RMS LON. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)

CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.011/ 7.5	.011/ 7.5	.012/ 7.5	.012/ 7.5	.013/ 7.5	.013/ 7.5	.013/ 7.7	.013/ 7.7	.013/ 7.5	.012/ 7.5	.012/ 7.5	.012/ 7.5	.012/ 7.5
	9	.017/ 9.5	.018/ 9.5	.018/ 9.5	.018/ 9.5	.019/ 9.5	.019/ 9.5	.019/ 9.5	.019/ 9.5	.019/ 9.5	.019/ 9.5	.018/ 9.5	.018/ 9.5	.018/ 9.5
	11	.021/ 9.8	.021/ 9.8	.022/ 9.8	.022/ 9.8	.022/12.6	.023/12.1	.023/12.1	.023/12.1	.022/12.6	.022/ 9.8	.022/ 9.8	.022/ 9.8	.021/ 9.8
	13	.026/14.6	.026/14.6	.025/14.6	.025/14.3	.025/14.0	.025/13.7	.025/13.7	.025/13.7	.025/14.0	.025/14.3	.026/14.6	.026/14.6	.026/14.6
	15	.030/15.7	.029/15.7	.029/15.7	.028/15.7	.027/15.3	.026/15.0	.026/14.6	.026/15.0	.027/15.3	.028/15.3	.029/15.7	.030/15.7	.030/15.7
	17	.032/17.0	.032/17.0	.031/17.0	.029/16.5	.028/16.5	.027/16.1	.026/15.7	.027/16.1	.028/16.5	.029/16.5	.031/16.5	.032/17.0	.032/17.0
	19	.033/18.0	.033/18.0	.031/18.0	.030/18.0	.027/17.5	.026/17.5	.025/17.0	.026/17.0	.027/17.5	.030/18.0	.032/18.0	.033/18.0	.033/18.0
	21	.033/19.0	.033/19.0	.031/19.0	.029/19.0	.027/18.5	.025/18.5	.024/18.0	.025/18.5	.027/18.5	.029/19.0	.031/19.0	.033/19.0	.033/19.0
5	7	.011/ 9.5	.011/ 9.5	.012/ 9.5	.012/ 9.5	.013/ 8.5	.013/ 8.3	.013/ 8.3	.013/ 8.1	.012/ 7.7	.012/ 7.7	.012/ 7.7	.011/ 7.7	.011/ 7.7
	9	.017/11.6	.017/11.6	.018/11.6	.018/11.6	.018/ 9.8	.019/ 9.8	.019/ 9.8	.019/ 9.0	.019/ 8.5	.018/ 8.3	.018/ 8.3	.018/ 8.3	.018/ 8.3
	11	.021/11.6	.021/11.6	.021/11.6	.022/11.6	.022/11.6	.022/11.6	.023/11.6	.023/11.6	.023/11.6	.022/11.6	.022/12.1	.022/ 8.3	.022/ 8.3
	13	.025/16.5	.025/16.5	.025/16.1	.025/16.1	.025/15.3	.025/14.6	.025/13.4	.025/13.1	.025/13.1	.026/13.1	.026/13.1	.026/13.4	.026/13.4
	15	.029/17.5	.029/17.5	.029/17.5	.028/17.0	.027/16.5	.026/16.1	.026/15.0	.026/14.3	.027/14.3	.028/14.3	.029/14.3	.030/14.3	.030/14.3
	17	.032/18.5	.032/18.5	.031/18.5	.029/18.0	.028/18.0	.026/17.0	.026/16.1	.027/15.3	.028/15.3	.030/15.3	.031/15.3	.032/15.3	.033/15.3
	19	.033/19.6	.033/19.6	.031/19.6	.029/19.0	.027/19.0	.026/18.5	.025/17.5	.026/16.5	.028/16.5	.030/16.5	.032/16.5	.033/16.5	.034/16.5
	21	.033/20.3	.032/20.3	.031/20.3	.029/20.3	.026/20.3	.025/19.6	.024/18.5	.025/18.0	.027/17.5	.029/17.5	.031/18.0	.033/18.0	.033/18.0
10	7	.011/12.8	.011/12.8	.011/12.8	.012/12.8	.012/ 9.5	.013/ 9.5	.013/ 9.5	.012/ 8.5	.012/ 8.1	.011/ 6.8	.011/ 6.8	.011/ 6.8	.011/ 6.8
	9	.016/14.6	.017/14.6	.017/14.6	.018/14.6	.018/12.1	.019/ 9.5	.019/ 9.5	.019/ 9.5	.018/ 9.2	.018/ 7.3	.018/ 7.3	.018/ 7.3	.017/ 7.3
	11	.020/14.6	.020/14.6	.021/14.6	.021/14.6	.022/14.6	.022/13.4	.023/11.6	.023/10.5	.023/10.5	.022/10.8	.022/10.8	.022/10.8	.022/11.2
	13	.025/18.5	.025/18.5	.025/18.5	.025/18.5	.025/18.0	.025/15.0	.025/13.1	.025/12.1	.026/12.1	.026/12.1	.026/12.1	.026/12.1	.026/12.1
	15	.029/19.6	.029/19.6	.028/19.6	.027/19.0	.027/18.5	.026/18.0	.026/15.0	.027/13.7	.027/13.4	.028/13.4	.029/13.4	.030/13.4	.030/13.4
	17	.032/20.3	.031/20.3	.030/20.3	.029/20.3	.027/19.6	.026/19.0	.026/17.5	.027/15.0	.028/14.6	.030/14.3	.031/14.3	.032/14.3	.033/14.3
	19	.033/21.7	.032/21.7	.031/20.9	.029/20.9	.027/20.9	.026/20.3	.025/18.5	.026/16.5	.028/15.7	.030/15.3	.032/15.3	.033/15.3	.034/15.3
	21	.033/22.4	.032/22.4	.031/22.4	.029/22.4	.026/21.7	.025/20.9	.024/19.6	.025/17.5	.027/16.5	.029/16.5	.031/16.5	.033/16.5	.033/16.5
15	7	.010/17.5	.010/17.5	.011/17.5	.011/14.3	.012/14.3	.012/14.3	.012/14.3	.012/ 9.0	.012/ 6.3	.011/ 6.3	.011/ 6.3	.010/ 6.3	.010/ 6.3
	9	.016/17.5	.016/17.5	.016/17.5	.017/17.5	.018/17.5	.018/14.3	.018/14.3	.018/ 9.0	.018/ 9.0	.018/ 8.7	.017/ 6.5	.017/ 6.5	.017/ 6.5
	11	.020/17.5	.020/17.5	.020/17.5	.021/17.5	.021/17.5	.022/17.5	.023/14.6	.023/10.1	.023/ 9.8	.022/ 9.8	.022/ 9.8	.022/10.1	.022/10.1
	13	.024/21.7	.024/21.7	.024/21.7	.024/21.7	.024/17.5	.025/17.5	.025/17.5	.025/11.2	.026/11.2	.026/11.2	.026/11.2	.026/11.2	.027/11.2
	15	.029/22.4	.028/22.4	.028/22.4	.027/22.4	.026/21.7	.026/20.9	.026/17.5	.027/12.6	.028/12.6	.029/12.6	.030/12.6	.030/12.6	.031/12.6
	17	.031/23.3	.031/23.3	.030/23.3	.029/22.4	.027/22.4	.026/21.7	.026/20.3	.027/14.6	.028/13.7	.030/13.4	.032/13.4	.033/13.4	.033/13.4
	19	.033/24.2	.032/24.2	.031/23.3	.029/23.3	.027/23.3	.026/22.4	.025/20.9	.026/15.3	.028/14.6	.030/14.6	.032/14.6	.033/14.6	.034/14.6
	21	.032/24.2	.032/24.2	.030/24.2	.028/24.2	.026/24.2	.024/23.3	.024/21.7	.025/17.5	.027/15.7	.029/15.7	.032/15.7	.033/15.7	.034/15.7
20	7	.009/13.4	.010/13.4	.010/13.4	.011/13.4	.011/13.4	.012/13.4	.012/13.4	.011/13.4	.011/13.4	.010/ 5.7	.010/ 5.7	.009/ 5.7	.009/ 5.7
	9	.015/28.6	.015/28.6	.016/28.6	.016/28.6	.017/13.4	.018/13.4	.018/13.4	.018/13.4	.018/ 8.3	.017/ 8.3	.017/ 5.7	.016/ 5.7	.016/ 5.7
	11	.019/23.3	.019/23.3	.019/23.3	.020/23.3	.021/23.3	.022/23.3	.022/ 9.5	.023/ 9.2	.023/ 9.2	.022/ 9.2	.022/ 9.2	.021/ 9.2	.021/ 9.2
	13	.024/26.2	.024/26.2	.024/26.2	.024/26.2	.024/23.3	.025/23.3	.025/20.3	.026/10.5	.026/10.1	.026/10.1	.027/10.1	.027/10.1	.027/10.1
	15	.028/27.3	.028/27.3	.028/26.2	.027/26.2	.026/26.2	.026/23.3	.026/23.3	.027/11.6	.028/11.6	.029/11.6	.030/11.6	.031/11.6	.031/11.6
	17	.031/27.3	.031/27.3	.030/27.3	.028/27.3	.027/27.3	.026/26.2	.026/23.3	.027/13.4	.028/12.6	.030/12.6	.032/12.6	.033/12.6	.033/12.6
	19	.032/27.3	.032/27.3	.031/27.3	.029/27.3	.027/27.3	.026/26.2	.025/24.2	.026/13.4	.028/13.7	.030/13.7	.032/13.7	.034/13.7	.034/13.7
	21	.032/27.3	.032/27.3	.030/27.3	.028/27.3	.026/27.3	.024/26.2	.024/24.2	.025/16.1	.027/15.3	.039/15.0	.032/15.0	.033/14.6	.034/14.6

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 47 - SHIP E, ROOT MEAN SQUARE LATERAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP E (MEMBRANE TANKS)

RMS LAT. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.019/ 8.5	.027/ 8.3	.042/ 7.9	.058/ 7.7	.071/ 7.7	.080/ 7.7	.084/ 7.5	.083/ 7.5	.077/ 7.5	.066/ 7.5	.052/ 7.5	.038/ 7.5	.030/ 7.7
	9	.036/10.5	.044/10.1	.062/ 9.5	.082/ 9.5	.098/ 9.5	.109/ 9.2	.114/ 9.2	.113/ 9.2	.104/ 9.2	.090/ 9.2	.072/ 9.5	.053/ 9.5	.045/ 9.8
	11	.049/11.6	.057/11.6	.073/11.2	.092/10.8	.108/10.8	.119/10.5	.124/10.5	.121/10.5	.112/10.5	.098/10.8	.080/11.2	.062/11.6	.054/11.6
	13	.055/12.8	.062/12.6	.076/12.6	.093/12.1	.108/12.1	.118/12.1	.122/11.6	.119/12.1	.111/12.1	.097/12.1	.081/12.6	.065/12.6	.059/12.8
	15	.056/13.7	.061/13.7	.074/13.4	.089/13.1	.102/13.1	.111/12.8	.114/12.8	.112/12.8	.104/13.1	.092/13.1	.077/13.4	.064/13.7	.059/13.7
	17	.054/14.6	.058/14.3	.069/14.3	.082/14.3	.094/14.0	.101/14.0	.104/14.0	.102/14.0	.095/14.0	.085/14.0	.072/14.3	.061/14.3	.056/14.6
	19	.050/15.3	.054/15.3	.064/15.3	.075/15.3	.085/15.3	.092/15.0	.095/15.0	.093/15.0	.087/15.0	.077/15.3	.066/15.3	.056/15.3	.052/15.3
	21	.046/16.1	.049/16.1	.058/16.1	.068/16.5	.077/16.5	.083/16.5	.085/16.5	.084/18.5	.078/18.5	.070/18.5	.060/18.5	.052/18.5	.048/18.5
5	7	.018/ 9.0	.026/ 8.7	.041/ 8.1	.057/ 7.9	.071/ 7.9	.080/ 7.7	.085/ 7.5	.084/ 7.5	.078/ 7.5	.068/ 7.3	.054/ 7.3	.039/ 7.1	.031/ 7.1
	9	.034/11.2	.043/10.5	.061/10.5	.080/ 9.8	.097/ 9.2	.109/ 9.2	.115/ 9.0	.114/ 9.0	.106/ 9.0	.092/ 9.0	.074/ 9.0	.056/ 9.0	.047/ 9.2
	11	.047/12.8	.054/12.8	.071/12.1	.090/11.6	.107/11.2	.119/10.8	.124/10.5	.123/10.5	.114/10.1	.100/10.1	.082/10.1	.065/10.5	.057/10.5
	13	.053/14.0	.059/14.0	.073/13.4	.091/12.8	.106/12.6	.117/12.1	.122/12.1	.120/11.6	.112/11.6	.099/11.6	.083/11.6	.068/11.6	.061/11.6
	15	.053/15.0	.058/14.6	.071/14.3	.086/14.0	.100/13.7	.110/13.4	.114/13.1	.113/12.8	.106/12.6	.094/12.6	.080/12.6	.067/12.6	.061/12.6
	17	.051/15.7	.055/15.7	.066/15.3	.080/15.0	.092/14.6	.100/14.3	.104/14.0	.103/13.7	.097/13.7	.087/13.4	.074/13.4	.063/13.4	.058/13.4
	19	.047/16.5	.051/16.5	.061/16.5	.073/16.1	.083/15.7	.091/15.7	.094/15.3	.093/15.0	.088/14.6	.079/14.6	.068/14.3	.058/14.3	.054/14.3
	21	.043/17.5	.047/17.5	.055/17.5	.066/17.5	.075/17.0	.082/17.0	.085/16.5	.084/16.1	.079/16.1	.071/15.7	.062/15.3	.053/15.3	.050/15.3
10	7	.017/11.6	.025/ 8.5	.040/ 8.5	.057/ 7.9	.070/ 7.7	.080/ 7.5	.085/ 7.5	.085/ 7.3	.079/ 7.0	.069/ 7.0	.055/ 6.8	.040/ 6.8	.032/ 6.7
	9	.032/12.8	.041/11.6	.059/11.6	.079/ 9.5	.097/ 9.2	.109/ 9.0	.115/ 8.7	.115/ 8.7	.107/ 8.5	.094/ 8.5	.076/ 8.5	.057/ 8.5	.048/ 8.5
	11	.044/14.3	.051/14.0	.068/13.1	.088/12.1	.105/11.6	.118/10.5	.124/10.1	.124/ 9.8	.116/ 9.8	.102/ 9.8	.084/ 9.5	.067/ 9.8	.059/ 9.8
	13	.049/15.7	.055/15.7	.070/14.6	.088/13.7	.104/13.4	.115/12.6	.122/11.6	.121/11.6	.114/11.2	.101/10.8	.085/10.8	.070/10.8	.063/10.8
	15	.050/16.5	.055/16.5	.068/16.1	.084/15.3	.098/14.3	.108/13.7	.114/13.4	.113/12.6	.107/12.1	.096/12.1	.082/12.1	.069/11.6	.063/11.6
	17	.047/17.5	.052/17.5	.063/17.0	.077/16.1	.090/15.7	.099/15.0	.104/14.3	.104/13.7	.098/13.4	.088/12.8	.076/12.8	.065/12.6	.060/12.6
	19	.044/18.0	.048/18.0	.058/17.5	.070/17.5	.081/16.5	.090/16.1	.094/15.7	.094/15.0	.089/14.3	.080/14.0	.070/13.7	.060/13.7	.056/13.4
	21	.041/18.0	.044/18.0	.053/18.0	.064/18.0	.074/18.0	.081/18.0	.085/17.0	.085/16.5	.080/15.7	.073/15.3	.063/14.6	.055/14.3	.051/14.3
15	7	.016/14.3	.024/ 9.2	.039/ 9.0	.056/ 7.3	.070/ 7.1	.080/ 7.0	.085/ 7.0	.085/ 6.8	.080/ 6.8	.070/ 6.7	.056/ 6.7	.040/ 6.4	.032/ 6.4
	9	.031/13.1	.039/13.1	.057/10.1	.078/10.1	.096/ 9.5	.109/ 8.7	.116/ 8.5	.115/ 8.3	.108/ 8.1	.095/ 8.1	.077/ 7.9	.059/ 7.9	.049/ 7.9
	11	.041/16.1	.048/16.1	.066/13.4	.086/13.1	.104/10.5	.117/10.1	.124/10.1	.124/ 9.5	.117/ 9.5	.104/ 9.2	.086/ 9.2	.069/ 9.0	.061/ 9.0
	13	.046/18.0	.052/18.0	.067/16.1	.085/14.3	.102/13.7	.115/13.1	.121/11.2	.122/10.8	.115/10.5	.103/10.1	.087/10.1	.072/10.1	.065/ 9.8
	15	.046/18.5	.051/18.5	.065/18.0	.081/16.5	.096/15.7	.107/14.0	.113/13.1	.114/12.8	.108/12.1	.097/11.6	.084/11.2	.071/10.8	.065/10.8
	17	.044/20.3	.049/18.5	.060/18.5	.074/18.0	.088/16.5	.098/16.1	.104/14.3	.104/13.7	.099/13.1	.090/12.6	.078/12.1	.067/12.1	.062/12.1
	19	.041/20.9	.045/20.3	.055/18.5	.068/18.5	.080/18.0	.089/17.0	.094/16.1	.094/15.0	.090/14.3	.082/13.7	.071/13.1	.062/12.8	.057/12.8
	21	.038/20.9	.041/20.9	.050/20.9	.061/18.5	.072/18.5	.080/18.5	.085/18.5	.085/16.5	.081/15.7	.074/14.6	.065/14.0	.056/13.7	.053/13.7
20	7	.015/14.0	.023/14.0	.039/ 9.8	.055/ 7.3	.070/ 6.8	.080/ 6.8	.085/ 6.7	.085/ 6.7	.080/ 6.7	.070/ 6.5	.056/ 6.4	.041/ 6.3	.032/ 6.3
	9	.029/19.0	.037/19.0	.055/14.6	.076/10.8	.095/ 8.1	.108/ 7.9	.115/ 7.9	.116/ 7.7	.109/ 7.7	.096/ 7.5	.078/ 7.5	.059/ 7.5	.050/ 7.5
	11	.038/19.0	.046/19.0	.063/19.0	.083/15.0	.102/10.8	.116/10.8	.124/ 9.5	.124/ 9.0	.118/ 8.7	.105/ 8.7	.088/ 8.5	.070/ 8.5	.062/ 8.5
	13	.042/23.3	.049/19.0	.064/19.0	.083/15.3	.100/15.3	.113/11.6	.121/11.2	.122/10.8	.116/10.1	.104/ 9.8	.089/ 9.5	.073/ 9.5	.067/ 9.5
	15	.042/23.3	.048/23.3	.061/19.0	.078/15.7	.094/15.3	.106/15.3	.113/12.1	.114/12.1	.109/11.6	.099/10.8	.085/10.5	.072/10.1	.066/10.1
	17	.041/23.3	.045/23.3	.057/23.3	.072/19.0	.086/16.1	.097/15.7	.103/15.3	.104/12.8	.100/12.6	.091/12.1	.079/12.1	.068/11.6	.063/11.2
	19	.038/23.3	.042/23.3	.053/23.3	.065/19.0	.078/19.0	.088/16.5	.093/16.1	.094/15.3	.091/14.3	.083/13.1	.072/12.6	.063/12.6	.059/12.1
	21	.035/23.3	.039/23.3	.048/23.3	.059/23.3	.070/19.0	.079/18.0	.084/17.5	.085/16.5	.082/15.3	.075/14.3	.066/13.7	.057/13.1	.054/13.1

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

TABLE 48 - SHIP E, ROOT MEAN SQUARE VERTICAL ACCELERATIONS AT CENTER OF FORWARD TANK, UNIT SIGNIFICANT WAVE HEIGHT

LNG SERIES: SHIP E (MEMBRANE TANKS)

RMS VER. ACC. IN G'S/ENCOUNTERED MODAL PERIOD, T_{OE}, IN SECONDS

(ACC. X 100)
CENTER OF FORWARD TANK

V	T_0	SHIP HEADING ANGLE IN DEGREES												
		0	15	30	45	60	75	90	105	120	135	150	165	180
0	7	.050/ 9.2	.055/ 9.2	.068/ 9.0	.082/ 8.7	.095/ 8.7	.104/ 8.7	.109/ 8.7	.108/ 8.7	.101/ 8.5	.091/ 8.5	.079/ 8.5	.069/ 8.5	.064/ 8.5
	9	.103/ 9.5	.113/ 9.5	.137/ 9.5	.164/ 9.5	.187/ 9.5	.203/ 9.5	.209/ 9.5	.205/ 9.5	.192/ 9.5	.172/ 9.5	.148/ 9.5	.128/ 9.5	.121/ 9.5
	11	.136/12.1	.146/ 9.8	.170/10.5	.199/10.5	.223/10.5	.240/10.5	.246/10.5	.242/10.5	.227/10.5	.205/10.5	.180/10.5	.160/11.2	.152/11.6
	13	.149/12.8	.157/12.8	.177/12.6	.200/10.8	.220/10.8	.235/10.5	.240/10.5	.236/10.5	.224/10.8	.205/11.2	.185/12.1	.169/12.6	.162/12.8
	15	.149/13.7	.155/13.7	.169/13.1	.187/12.6	.203/11.2	.214/10.8	.218/10.8	.215/11.2	.205/11.2	.191/12.6	.176/13.1	.164/13.4	.159/13.7
	17	.141/14.3	.146/14.3	.156/14.0	.169/13.4	.181/12.6	.190/11.6	.193/11.2	.191/11.6	.183/12.1	.172/13.1	.161/13.7	.152/14.0	.149/14.0
	19	.130/15.0	.134/15.0	.141/14.6	.151/14.0	.160/13.1	.167/12.1	.169/11.6	.168/12.1	.162/13.1	.154/14.0	.145/14.3	.139/14.6	.137/14.6
	21	.119/15.7	.121/15.3	.127/15.3	.134/14.6	.141/14.0	.146/12.6	.148/12.1	.147/12.6	.143/13.7	.137/14.6	.130/15.0	.125/15.3	.123/15.3
5	7	.057/ 9.5	.063/ 9.5	.075/ 9.2	.089/ 9.0	.101/ 9.0	.108/ 9.0	.110/ 9.0	.106/ 8.7	.097/ 8.7	.084/ 8.5	.069/ 8.3	.057/ 8.3	.052/ 8.3
	9	.091/10.1	.103/10.1	.129/10.1	.158/ 9.8	.183/ 9.8	.201/ 9.8	.209/ 9.8	.206/ 9.5	.194/ 9.5	.174/ 9.5	.150/ 9.5	.130/ 9.8	.123/ 9.8
	11	.110/11.6	.123/11.6	.150/10.5	.183/10.5	.212/10.1	.235/10.1	.247/10.1	.249/10.1	.241/10.1	.224/10.5	.203/10.5	.186/10.5	.179/10.8
	13	.119/14.6	.128/14.6	.151/11.6	.179/10.5	.207/10.5	.229/10.5	.243/10.5	.248/10.5	.245/10.8	.234/10.8	.220/11.2	.208/11.2	.204/11.2
	15	.118/15.3	.125/15.3	.143/15.0	.166/11.6	.188/10.8	.208/10.8	.222/10.8	.229/10.8	.228/11.2	.223/11.2	.214/11.6	.207/11.6	.204/11.6
	17	.113/16.1	.118/16.1	.131/15.7	.149/15.3	.168/11.6	.184/11.2	.197/11.2	.204/11.2	.206/11.6	.203/11.6	.198/12.1	.194/12.1	.192/12.6
	19	.104/17.0	.108/17.0	.119/16.5	.133/16.1	.148/14.6	.162/11.2	.173/11.2	.180/11.6	.182/11.6	.182/12.1	.179/12.6	.176/12.8	.175/12.8
	21	.096/17.5	.099/17.5	.107/17.0	.118/16.5	.130/15.7	.142/11.6	.151/11.6	.158/11.6	.161/12.1	.161/12.6	.160/13.1	.159/13.1	.158/13.1
10	7	.043/10.5	.054/ 9.5	.074/ 9.2	.093/ 9.0	.107/ 9.0	.115/ 9.0	.116/ 9.0	.110/ 8.7	.099/ 8.7	.083/ 8.5	.065/ 8.5	.050/ 8.1	.045/ 7.5
	9	.070/11.6	.085/10.8	.117/ 9.8	.150/ 9.5	.178/ 9.5	.198/ 9.5	.207/ 9.5	.205/ 9.5	.193/ 9.5	.172/ 9.5	.147/ 9.5	.126/ 9.5	.118/ 9.5
	11	.084/14.3	.099/11.6	.131/10.5	.168/10.5	.202/ 9.8	.231/ 9.8	.249/ 9.8	.257/ 9.8	.253/ 9.8	.240/ 9.8	.222/10.1	.207/10.1	.201/10.1
	13	.091/17.0	.102/17.0	.129/11.6	.162/10.8	.196/10.5	.226/10.5	.249/10.1	.263/10.1	.268/10.5	.265/10.5	.257/10.5	.249/10.5	.246/10.5
	15	.091/18.0	.100/18.0	.121/17.5	.149/11.6	.178/10.8	.207/10.5	.230/10.5	.247/10.5	.256/10.5	.259/10.8	.258/10.8	.255/10.8	.254/10.8
	17	.088/18.5	.094/18.5	.111/18.0	.133/17.5	.158/10.8	.183/10.8	.205/10.8	.222/10.8	.233/10.8	.239/10.8	.241/11.2	.242/11.2	.241/11.2
	19	.082/19.0	.087/19.0	.100/19.0	.119/18.0	.140/10.8	.161/10.8	.181/10.8	.197/10.8	.208/10.8	.215/11.2	.219/11.2	.220/11.2	.221/11.2
	21	.076/19.6	.080/19.6	.090/19.6	.105/19.0	.123/17.5	.141/10.8	.159/10.8	.173/10.8	.184/11.2	.191/11.2	.196/11.2	.198/11.6	.199/11.6
15	7	.040/ 9.2	.055/ 9.2	.079/ 9.2	.100/ 9.0	.115/ 9.0	.123/ 9.0	.124/ 9.0	.117/ 9.0	.103/ 9.0	.084/ 9.0	.064/ 8.5	.049/ 8.1	.044/ 8.1
	9	.058/10.1	.077/10.1	.112/10.1	.146/ 9.8	.176/ 9.5	.196/ 9.5	.206/ 9.5	.204/ 9.2	.191/ 9.2	.170/ 9.2	.143/ 9.2	.120/ 9.2	.111/ 9.2
	11	.067/13.1	.084/10.1	.119/10.1	.159/10.1	.197/10.1	.229/ 9.8	.252/ 9.5	.263/ 9.5	.263/ 9.5	.253/ 9.5	.237/ 9.5	.223/ 9.5	.217/ 9.5
	13	.071/20.9	.084/20.9	.114/10.1	.152/10.1	.191/10.1	.228/10.1	.258/10.1	.280/10.1	.292/10.1	.295/10.1	.292/10.1	.288/10.1	.286/10.1
	15	.071/20.9	.081/20.9	.105/20.9	.138/10.1	.174/10.1	.210/10.1	.242/10.1	.268/10.1	.287/10.1	.298/10.1	.303/10.1	.304/10.1	.304/10.1
	17	.069/21.7	.076/21.7	.096/21.7	.123/10.5	.154/10.1	.187/10.1	.218/10.1	.244/10.1	.265/10.1	.279/10.5	.288/10.5	.292/10.5	.294/10.5
	19	.065/22.4	.071/22.4	.086/21.7	.109/20.9	.136/10.5	.165/10.1	.192/10.5	.217/10.5	.238/10.5	.253/10.5	.263/10.5	.268/10.5	.270/10.8
	21	.061/22.4	.065/22.4	.078/22.4	.096/21.7	.119/10.5	.144/10.5	.169/10.5	.192/10.5	.211/10.5	.225/10.5	.235/10.8	.241/10.8	.243/10.8
20	7	.039/ 9.8	.055/ 9.8	.080/ 9.8	.101/ 9.8	.117/ 9.8	.125/ 9.8	.126/ 9.8	.119/ 9.8	.105/ 9.8	.085/ 9.5	.063/ 8.1	.047/ 7.9	.042/ 5.2
	9	.052/10.5	.071/10.1	.107/ 9.8	.141/ 9.8	.171/ 9.8	.192/ 9.8	.202/ 9.5	.200/ 9.5	.188/ 9.0	.166/ 9.0	.139/ 9.0	.114/ 9.0	.105/ 9.0
	11	.055/15.3	.073/10.8	.110/10.5	.151/ 9.8	.192/ 9.8	.228/ 9.5	.254/ 9.5	.268/ 9.5	.270/ 9.5	.261/ 9.5	.246/ 9.5	.231/ 9.5	.225/ 9.5
	13	.057/23.3	.071/23.3	.103/10.8	.144/ 9.8	.189/ 9.8	.231/ 9.8	.268/ 9.8	.296/ 9.5	.314/ 9.5	.321/ 9.5	.321/ 9.5	.319/ 9.5	.317/ 9.5
	15	.056/26.2	.067/23.3	.094/10.8	.130/10.1	.173/ 9.8	.216/ 9.8	.256/ 9.8	.290/ 9.8	.317/ 9.8	.334/ 9.8	.344/ 9.8	.349/ 9.8	.350/ 9.8
	17	.054/26.2	.063/26.2	.085/26.2	.116/10.5	.153/10.1	.194/ 9.8	.233/ 9.8	.268/ 9.8	.297/10.1	.318/10.1	.333/10.1	.341/10.1	.344/10.1
	19	.052/27.3	.058/27.3	.076/26.2	.102/10.5	.135/10.1	.171/10.1	.207/10.1	.240/10.1	.268/10.1	.291/10.1	.307/10.1	.316/10.1	.319/10.1
	21	.048/27.3	.054/27.3	.068/27.3	.090/10.8	.119/10.1	.150/10.1	.182/10.1	.213/10.1	.239/10.1	.260/10.1	.276/10.1	.285/10.1	.288/10.1

NOTE: V IS SHIP SPEED IN KNOTS AND T_0 IS MODAL WAVE PERIOD IN SECONDS.

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